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CONTENTS.

Annual Banquet, American Institute of Electrical Engineers .....Supplement
The Traction Dinner of the Institute 320
Editorial 325
A New York City Municipal Lighting Plant 328
Exposition Gold Medals 328
Lectures at Brooklyn Polytechnic 328
The Present Status of Electric Furnace Working 328
The "Leave Out" Municipal Estimates 329
The Traction Dinner of the American Institute of Electrical Engineers .. 329
Electrical Engineers of the Times—VII. H. P. Maxim 332
Current News and Notes 332
The Westinghouse Single-Phase Railway System in Operation 335
A British Switchgear for Sub-station Control 339
Cross-Connection of Series Motors. By D. Kos 342
A New Design for Slow Speed Induction Motors. By Prof. Clarence P. Feldman 343
Some Data of the A. E. G. Steam Turbine. By Franz Koester 344
The Choice of Signs in Wattmeter Problems. By L. A. Freudenberger .. 346
The Handling of Delinquent Accounts. By W. H. Winslow 347
Starting Device for Mercury Vapor Lamps 349
New Telephone Patents 349
LETTERS TO THE EDITORS:
Cost of Electric Power to Consumers. By Charles L. Jones 350
Power Factor Indicators. By W. F. Shaw 350
Digest of Current Electrical Literature 351
Book Reviews 355
Closing Bulkhead Doors by Electricity 355
National Electrical Contractors' Association 356
Portable Forges 357
The De Forest Wireless Telegraph Station at Chicago Opened 357
Protective Device for Variable-Speed Motors 357
Walrath Gas Engine 357
Recent Improvements in Nernst Lamps 359
Motor-Starting Panels with Circuit-Breakers 360
Sangamo Direct-Current Watt-Hour Meter 361
Electrical Revolving Display Case 361
Electrically Operated Whistle 362
Big Electric Crane Concerns to Consolidate 362
Automatic Time Switch 363
Security Pole Seats 363
Ball Bearings for Electric Motors 363
Industrial and Commercial News 364
General News of the Week 367

"LEAVE OUT" ESTIMATES.

A very interesting addition to the recent discussion over the value of Mayor Harrison's claims as to the cheapness of electric lighting from the Chicago municipal plant is made by President Davis, of the National Electric Light Association, as quoted elsewhere in these pages. He notes the fact that Mayor Harrison "leaves out" water, insurance and taxation, for some plausible reason or other. Of course, a private plant cannot leave them out for any reason, plausible or otherwise. There is for it no person around the corner, resolving himself in the ultimate analysis into the poor taxpayer, to see that these items are finally cared for somehow in keeping the municipal plant in operation. But Mr. Davis instances a number of other "leave out" items. No fellow that ever took a girl to the theatre has tried to fool himself into the belief that the two seats in the orchestra were the only expense; but that is what the "municipalites" are doing all the time. Mr. Davis makes pertinent inquiries as to legal services involved; damage suits; cost of the city purchasing department; relaying pavement; use of poles of other departments and kindred items, all of which are "left out." He then makes some very definite and derogatory statements as to the nature of the lighting—which nobody can deny.

The same incurable tendency to "leave out" vital items, by instruction or otherwise, appears in the revised estimates for a New York City plant just presented by well-known experts—able engineers, but not one of whom ever operated a large central station or is likely to do so. The sum of four million dollars is proposed as the outlay for a restricted service, and by "leaving out" all kinds of items, an apparent economy and saving is arrived at. The estimates in the light of the truth and the facts are subject to serious revision; and when all the data are in, putting the public and the private service on an equal comparison, we believe the showing will favor the private service all through. Meantime, while the proposal is afoot to spend four millions of taxes on a limited plant, we shall be glad to help a movement turning the municipal police service over to a private firm, by contract. Nothing is too bad to be said about the municipal plant for police supply, by some of the papers that are perfectly frantic for a municipal lighting supply.

MERCURY ARC RECTIFIERS.

It is always a source of regret that although so much electric power is generated and transmitted in the form of alternating currents, yet much of it is consumed and distributed in the form of direct currents, thus requiring the intermediary of the converter, i. e., rotating apparatus. There ought to be no revolving commutators between the generator and the motors. Of course, the conditions of power transmission have to be treated as they are, and not merely as they ought to be. The converter is in very extended use and does its work wonderfully well. Nevertheless, the contrast between a converter and a transformer, for the same power delivery, is very marked and altogether in favor of the latter. For these reasons the mercury arc converter has been hoped for by station managers ever since it became known that a glass tube containing mercury vapor at low pressure possessed the property of giving passage to currents in one direction and not in the other.

It is interesting to observe that a charging equipment for electric automobiles has recently been placed on the market, for charging storage batteries from alternating-current mains through a mercury

arc rectifier. The apparatus, which takes the place of a motor-generator or converter, is mounted upon an ordinary switchboard panel provided with switches, measuring instruments and a dial rheostat connected to the different parts of a reactance coil. The principal feature of the panel is, however, the mercury arc tube, in the form of an inverted crucifix, with one cathode, lowermost, and three anodes, one of which is used only in starting the tube. The capacity of the apparatus is limited, at present, to thirty amperes; but even thirty amperes of rectified current without any rotating apparatus or commutator is a decided boon. The mercury rectifier is understood to consume about 15 volts drop in its vapor column, including its electrodes. This is the charge that it makes for performing its functions. The efficiency of conversion tends, therefore, to increase with the voltage of the circuit. Nevertheless, the efficiency of the mercury rectifier is stated to be greater than that of a motor-generator set, of equal power, and also to possess a higher power factor. There can be no doubt that the extent to which electric automobiles can be employed in urban or suburban service depends upon the facilities which are afforded for recharging storage batteries at various stations distributed throughout the district. Simple and convenient apparatus for delivering power to automobiles from alternating current, as well as from direct-current mains, should materially assist the development.

ELECTRIC DOUBLE REFRACTION IN CARBON BISULPHIDE.

In the last number of the *Physical Review,* there is an article by Mr. G. W. Elmen, on some optical experiments with carbon bisulphide, a transparent insulation liquid which has been much used by physicists in electro-optical work. It is well known that when ordinary light passes through a Nicol's prism, it becomes polarized—that is, its electric waves are all in one plane and its magnetic waves are all in the plane perpendicular thereto. This polarized light differs from ordinary light in the fact that ordinary light has no particular plane of electric vibration and, therefore, no particular plane of magnetic vibration. It is made up, in fact, of a vast assemblage of elementary rays, each one of which has one particular pair of planes, but these planes are distributed unselectively in all directions. In polarized light this heterogeneous assortment of planes of vibration is suppressed, and one electric plane only, with its corresponding perpendicular magnetic plane, is established. The waves of wireless telegraphy resemble polarized light waves of great length, for their electric vibrations are up and down, or perpendicular to the ground, while their magnetic vibrations are horizontal. It is also known that when a plane-polarized ray traverses a column of such a liquid as carbon bisulphide in the ordinary state, no perceptible change occurs in the plane of polarization. The light emerges from the end of the liquid column still electrically vibrating in the original plane, and magnetically vibrating in the plane perpendicular thereto.

But if the column of carbon bisulphide is at the same time subjected to a transverse electric stress, in a plane midway between the electric and magnetic planes of the entering light, the single-phase polarized light will be split up into two rotating-field components, one right-handed and the other left-handed and with a certain difference of phase between them. The difference of phase is found to depend proportionately upon the length of the stressed dielectric column; the greater the length, the greater the phase difference. It also increases as the square of the electric intensity, as measured, say, in volts per millimeter. The effect is small, and a column of the carbon bisulphide about half a meter long, subjected laterally to an electric intensity of 500 volts per millimeter, will only effect a phase difference in the rotating fields, for yellow light, of about ten degrees. As the intensity diminishes, the phase difference should, by the formula, diminish as the square, so that at, say, 100 volts per millimeter, the phase difference should be correspondingly two-fifths of one degree.

The paper describes a number of optical measurements made on such a liquid column having a pair of parallel metallic side walls, connected, through insulated leads, to a storage battery, the voltage of which could be varied at will from 200 to 1,400. The results reported indicate that the formula applied between 200 and 600 volts per millimeter of electric intensity. Below 200, however—that is, for weak electric stresses—the formula did not seem to hold, the phase difference observed being actually a fraction of one degree, but considerably more than the formula would require. In fact, at low intensities the effect was as though the intensity was, say, twice as great as measured by voltmeter. The question arises as to the source of the discrepancy. It is suggested in the paper that the effect may be similar to the magnetic permeability of iron, which is relatively large for small magnetic forces, and becomes practically unity for very large magnetic forces. Before accepting this conclusion, however, it would be well to have the observation corroborated by other observers. It is evidently difficult to make good measurements of the optical phase difference, when the latter is less than one degree, and when, as in this case, the electric force is less than 200 volts per millimeter. The observations recorded in the neighborhood of this low force vary greatly among themselves, and it may be possible that further investigation might cause the discrepancy to disappear.

A CONFESSION OF DEFEAT.

At a recent indignation meeting of Long Island commuters during which President Potter, successor of the lamented Mr. Baldwin in the Long Island Railroad, attempted to justify his policy of reducing acommodations and raising fares, he is quoted as saying that no steam railroad in existence can successfully compete with the electric railways. This is a broad statement probably justified by the facts, but we had hardly expected to hear so whole-souled a confession of defeat in spite of the growing feeling to that effect among far-sighted railway men. But we wonder whether the thrifty Mr. Potter has ever seriously considered the causes which have been operative in bringing about the state of things which he so profusely laments. Did it ever occur to him that the close adaptation of electric railway service to the needs of the people, and the liberal policy of electric railway managers in following up these needs, have had anything to do with the matter? Has he duly weighed the fact that the electric railways by adopting a policy of low fares and frequent service have won and will hold their present place in the life of the people, and that this competition cannot be met by high fares and bad service? Whenever a well-managed electric road has come into open competition with a steam suburban service as commonly conducted, it has obtained the lion's share of the business, not because it ran by a new motive power as because it carried people somewhere nearly where they desired to go somewhere about the time convenient for them and for a very low price. And the steam roads instead of taking the hint have been bitterly aggrieved that some one else gave the public more for its money and have exhausted the resources of the law and the lobby to prevent competition instead of meeting it on its merits.

We know of no reason why the railroads deserve sympathy in their self-inflicted punishment. When a manufacturing establishment has prospered for many years on a virtual monopoly and finds itself finally confronted by a competitor with processes able to produce better goods for less money, can it help matters by raising its prices and putting its best customers on the C. O. D. list? Not a bit of it! It can put in new equipment and meet the newcomer on

its own ground, or if it does not fancy that horn of the dilemma, it can take the other and go to the wall. It may whine around and try to find some excuse for making its customers pay for its re-equipment, but the solemn truth is that a factory or a railroad that makes no provision for probable changes in the art is eating up its capital in the hope that the ultimate and inevitable losses will fall upon some one else. As a matter of fact, the electric railways have suffered acutely from changes in the art, but they have met them promptly and have prospered accordingly. The steam roads have simply kicked against the pricks year after year, have seen suburban traffic go more and more to their competitors, and cap the climax by grumbling over their hard lot and raising fares. No better way could be found of playing into the hands of their competitors. If they believe, as they have good reason, that the electrically-equipped line can handle traffic more cheaply than they themselves can, they should get upon an electrical basis at the earliest possible moment, charging up the change to profit and loss and not further watering their stock to furnish a further excuse for wails of small profits and pleas for increased fares. The more enlightened railway men fully understand the situation and are ready to move at once.

There is another side to the situation. The time is rapidly approaching in which railroads both steam and electric will have to reckon with the public if they try to adopt high-handed tactics. If a road pays unearned dividends on watered stock by neglecting upkeep improvements and provision for future contingencies, it deserves no consideration whatever if it gets into financial difficulties. A proposition to recoup itself by raising fares is morally speaking just plain welching. And from the bills now before Congress railroads will find themselves blocked in such dubious schemes at no distant day. We certainly do not wish to see Governmental ownership of railways, steam or electric, but strict Government control, including control of rates, is extremely likely to come and will be hastened by every such pronunciamento as that delivered by Mr. Potter. If interstate rates are thus controlled it will be but a short step to State control of internal rates. The results of private bad judgment or bad management cannot always, as now, be shuffled off upon the public, and the wise railway man will look ahead instead of shutting his eyes. A prominent street railway man recently proposed raising fares as a refuge from financial difficulties on certain electric roads. Did it ever occur to him, we wonder, that people who make bad investments or mismanage their business must expect loss, and ought not to be permitted to foist it upon the public? Most electric roads fortunately can and do struggle along until prosperity comes, and can hold their own with the steam roads while meeting the public more than half way in fares and facilities. When a steam road finds itself hard pressed by electric competition, the very best thing for it to do is to come down from its high horse and busy itself about improvement that shall win the traffic that pays. We believe that in the next few years many steam roads will be converted to electric roads as regards passenger traffic at least, and that they will find the change a source of profit. And whether they change motive power or not they will find that the road to success lies in attracting business instead of repelling it, and in making friends instead of enemies.

LOAD DIAGRAMS AND THEIR USES.

The importance of keeping proper load diagrams of the power delivered by a central station has long been recognized by central station managers. In electric lighting the daily peak of the load indicates at a glance the maximum amount of power that the station will probably be called upon to furnish from day to day. Moreover, by preparing load diagrams for different months in the year, the range of delivery between Christmas week and the midsummer season was also clearly indicated. The next step in the use of the load diagram was to determine the load factor, or ratio of average to maximum power, referred to the day, month or year of operation. The station manager's efforts to improve the returns upon the investment under his charge could be conveniently aided by seeking to improve the load factor, and improving the load diagram from which it was deduced. The peak of the load could be cut off the engines and imposed upon storage batteries receiving their charge from the engines at hours of light load, thus distributing the delivery of the station more uniformly during the twenty-four hours and smoothing out the load diagram.

The extension of the load diagram from electric lighting to other classes of electric distribution has elicited some remarkable facts connected with the habits of communities, and which possess interest for all students of sociology. A pure lighting load diagram has almost invariably but one peak in the twenty-four hours. The time of day at which the peak occurs depends upon the latitude, the season, the weather, the class of service (business or residence) and the average social conditions. In a business district the peak will occur late in the afternoon, and shortly before office closing time. In a residence district it will occur just before the average dining hour. The average time of closing up the houses at night can also be distinctly perceived. One and the same community, under the same conditions of weather and season, will dine and shut up house for the night with a routine precision that suggests the action of an automaton. Theatre lighting and saloon lighting are, of course, distinct and independent factors having rules of their own. When motors are supplied from a lighting system they not only modify the levels of the load diagram, but they also affect its shape. They tend to produce a noon hour notch or groove, the factories employing the motors usually stopping their rotation during the noon hour; or if the motors continue to run, the load of the tools is removed.

In city electric railway operation the load diagram is double-peaked. The morning load carries the people to their work in the city. The evening load carries the people homewards. In a factory town the two peaks usually display remarkable symmetry, since almost all the passengers carried go to work at one time, and leave at one time. In a mixed community, however, with stores, offices and factories, the evening peak of home returning is usually distinctly higher, sharper and steeper than the morning peak, since people of all classes tend to go home at nearly the same evening hour; but the time of starting work in the morning may extend from say 7 a.m. for factory workers to 11 a.m. for purchasers in stores, or dilettantes in business. In telephony the load diagram is equally characteristic and equally replete with interest. The diagram generally has two peaks, the valley between them representing the luncheon hour. Not only do persons not call up frequently at this time, because they themselves are away at lunch, but also because they deem it undesirable to call up an interlocutor, since he is likely to be absent at lunch. The load diagram of a telephone station is more nearly uniform than that of a lighting station, in regard to the season of the year; but is also affected by weather, climate and social conditions. To different persons the load diagram of any electric distribution tells a different story, depending upon the duties, responsibilities and mental attitude of the observer. The investor, the manager, the president, the operator, the engineer, all look at the diagram from different standpoints; but it has its own value to each. It is, moreover, evident that much can be learned about the goings and doings of a community by studying its load diagrams intelligently.

A New York City Municipal Lighting Plant.

At the meeting of the New York City Board of Estimate last week Mayor McClellan presented the preliminary report of the commission he appointed to prepare plans for municipal lighting plants. The members of the commission are Cary T. Hutchinson, George F. Sever and Nelson P. Lewis. The report does not seem to differ in any particular respect from an earlier one. The estimated cost of complete plants for providing 6,000 arc electric lamps and 250,000 16-cp incandescent lights is $4,100,000 exclusive of the cost of real estate. The commissioners in their report say that they have decided on two sites for power houses, but the locations are not made public. They ask permission to consult privately with the Comptroller in order that the city may obtain options on the land.

The report says that the total cost of a power station with 10,000 kw power, exclusive of real estate, will be $1,250,000, and the cost of high-pressure cables, sub-stations and all details for 6,000 arc lights and 250,000 16-cp incandescent lights, $2,850,000.

The estimated cost a year of arc lamps, including interest on bonds and depreciation of plant is placed at $75.40. The cost a year of the 16-cp incandescent lights is fixed at $5.15. The total annual cost of operating the proposed plants is estimated in the report at $906,000. The estimates do not include any cost for the construction of ducts or rental for them, because the city is assumed to have the right to use the ducts of the private subway companies. Apparently no allowance is made for the costly "service" connections necessary. Other items of expense are apparently "left out."

Exposition Gold Medals.

The International Committee of the Louisiana Purchase Exposition has recognized the engineering ability of the designers of the apparatus exhibited by the General Electric Company, in awarding grand prizes as follows:

To Elihu Thomson, Swampscott, Mass., for various applications of electricity; also to C. P. Steinmetz, Schenectady, N. Y., for electric lighting, and to F. J. Sprague, New York City, for application of electricity to transportation.

It has also awarded gold medals to C. G. Curtis, of New York City, "the originator of a successful American multi-stage steam turbine"; to W. L. R. Emmet, of Schenectady, N. Y., "designer of the vertical type of Curtis steam turbine and generator"; and to W. B. Potter, Schenectady, N. Y., for applications of electricity to transportation.

They have also awarded silver medals to W. S. Moody, Schenectady, N. Y., for transformers; to E. M. Hewlett, Schenectady, N. Y., for distribution of energy, switchboards, etc.; to H. F. T. Erben, Schenectady, N. Y., for apparatus for generating electricity; to H. G. Reist, Schenectady, N. Y., for apparatus for generating electricity; to L. T. Robinson, Schenectady, N. Y., for scientific apparatus, measuring apparatus and laboratory and standard instruments, and to F. P. Cox, Lynn, Mass., for measuring instruments, indicating, recording and integrating.

Lectures at Brooklyn Polytechnic.

The first of a series of eight two-hour lectures on electrical power transmission was given on February 9 at the Brooklyn Polytechnic Institute by Prof. Frederic A. C. Perrine, the well-known consulting engineer on long-distance electric power transmission. This lecture was on the "Economics of Transmission Problems," and was divided by the speaker under seven heads: 1, adequacy of supply; 2, extent of market—(*a*) in existence, (*b*) to be developed; 3, character of market—(*a*) classes of industries well adapted to electrical application, (*b*) industries where the use of power is unimportant, (*c*) industries where steam itself is necessary, (*d*) industries requiring electricity; 4, competitive fuels; 5, transportation; 6, distribution; 7, importance of controlling property.

Prof. Barstow also gave on February 14 the sixth lecture on "Central Station Practice," this being devoted to distributing systems. A very interesting historical review was given of the former distributing systems and how the adoption of polyphase alternating-current generation has simplified the problem of giving consumers in the most economical manner just the kind of current they need. Prof. Barstow also went into the construction details of distributing systems, such as ducts, cables, manholes, handholes, etc.

The Present Status of Electric Furnace Working.

At the regular meeting of the electrical section of the Western Society of Engineers, held February 10, in the Monadnock Block, Chicago, Prof. Charles F. Burgess, of the University of Wisconsin, presented a paper entitled "The Present Status of Electric Furnace Working." The paper was rather general in character, dealing with the construction and operation of furnaces and their products.

Comparatively little attention, he said, was devoted to the electric furnace until twenty-five years ago, when Sir William Siemens devised and exhibited his furnaces for melting platinum, iron and other metals. Since that time a new chemistry of high temperatures has been evolved and new ideas concerning the constitution of matter have been developed by its use.

The statement that magnesia, tungsten and other substances are infusible, Prof. Burgess said, was incorrect, since all substances could be melted in the electric furnace. All the oxides which had hitherto been regarded as irreducible have been reduced in it. The most important industrial application made of the furnace so far is in the production of aluminum, the price of this metal being reduced from five dollars to thirty cents per pound. Concerning the advantages of the electric furnace over other means of generating heat, the chief one is the degree of temperature available. As well as can be measured, the temperature of the electric arc is from 3,600° to 4,000° C. The temperature is limited only by the inability to retain the heated gases. The fact that in the electric furnace there are no products of combustion to contend with, and that the heat may be developed in a compact and limited space makes the furnace more valuable.

The choice of materials for furnace construction is governed by the nature of the charge; that is, whether it be basic or acid. For an acid, silica is the most satisfactory lining. A basic lining may be made of magnesite bricks. When carbon and graphite are used as electrodes a large portion of the cost of maintenance is in the replacement of the electrodes burned away. Iron electrodes are sometimes employed, these being water-cooled. An appreciable quantity of heat, however, is carried away by the water when this method is used. A design of furnace avoiding the use of electrodes uses the resistance material as the secondary of a transformer. Only conducting materials can be heated in this type of furnace.

A commercial efficiency of 75 per cent. is readily obtainable in furnaces ranging in size from 200 to 1,000 hp. This compares very favorably with the steam boiler furnace at 50 to 60 per cent. and the reverberatory furnace for pig iron at 8.5 per cent. efficiency.

The electric furnace, Prof. Burgess said, seems to point the way to a limitless outlet for all the electric energy that can be produced. In the open discussion which followed the reading of the paper, Prof. Jackson, of the University of Wisconsin, stated that he had all confidence in the electric furnace as a revolution producer. It would no doubt revolutionize processes of manufacture and change the value of commodities.

Mr. F. Lubberger said he did not believe the chemical changes taking place in an electric furnace were produced by the heat action alone, but that free moving electrons were partly responsible for the changes.

The "Leave-Out" Municipal Estimates.

President E. H. Davis, of the National Electric Light Association, has been conducting in the hospitable columns of the Brooklyn *Eagle* a discussion as to the intrinsic value of the figures cited to show the low cost of municipal plant lighting in Chicago. These figures have already been quoted and discussed in the columns of ELECTRICAL WORLD AND ENGINEER. Mayor Harrison's figures are, as usual, noteworthy for what they leave out, and this fundamental weakness is criticized very forcibly by Mr. Davis as follows:

"Insurance, taxation and water, even if omitted, as Mayor Harrison contends they should be, are in their aggregate a relatively small item. The sum represented would make little difference in the

final result. But they show the extent to which he is willing to divest this questionable enterprise of every possible charge to make a better showing in his public statements. He does not contend that taxes would not, or should not, be paid by the private companies; he eliminates all kinds of insurance, but does not say why municipal should be less careful or foresighted than private management, and explanation is lacking as to why $18,000 in annual water consumption is a debt discharged with possibly $3,000 in annual light value—for accepting his own figures the Water Department consumes in light no more than that sum. As small as these items are relatively, their necessary elimination in municipal competition with private service simply emphasizes the straits into which our friends the advocates of municipal ownership are driven.

"Mayor Harrison does not tell us that the Electric Light Department secures the legal services of the city without charge; he does not state the extent to which in seventeen years the city has become liable for damages to employes or the public; he does not explain that the purchasing department of the city buys all the supplies for the lighting department without charge; that the relaying of the pavement, either for original underground work or repair, does not appear as a charge against the lighting service, but against some other department. No statement I have seen makes it clear that the cost of the large offices of the lighting department is not charged to the lighting account. He does not explain the very large extent to which the lighting department uses the poles of other departments and companies for holding its wires, for which no charge is made against the public lighting. And he compares the results so divested on a system of lighting of which two-thirds is by overhead wires, with a system entirely underground, supplied at a figure that is comprehensive of every charge from taxes and interest to legal services, damages and administration."

As to the lighting itself, Mr. Davis remarks: "That the street lighting of Chicago is of a very unsatisfactory nature is generally known. Frequently lamps supposed to give 2,000 cp will have nothing more than a dull glow at the carbon points, and illumination of any value whatsoever is confined to a very short radius. Through a recent expert investigation of the plants and methods employed, the reason has been made apparent. During a number of inspections late in January of this year it was found that the circuits are being operated with from 15 per cent. to 25 per cent. less current than they require, which means corresponding reduction in the cost of operation and an even greater reduction in the volume of light given.

"In a great many instances also 1,200-cp lamps have been used which are rated equally with those of 2,000 cp. It was also found during the inspection to which I refer that large numbers of the lamps are out of service nightly, and that when extinguished during the early hours of the evening they remain out until morning. It is usual to penalize the private companies for outages of this nature, but in Chicago nothing of the sort seems to exist. To correct these evils—for no other term may be correctly used—it would be necessary to entirely reconstruct the plant, and it needs no argument to show that giving the lamps the proper amount of current the running expenses would increase in equal, if not greater, proportion.

"It is not improper to conclude from the reports that have been prepared upon these plants that as expensive and as obsolete as they and their attendant systems are they are maintained with an utmost disregard for the quality of the service that is given—seemingly for the purpose of eliminating every possible element of expense at a time when the record made in this enterprise is of much importance in the political destinies of those responsible for it."

Canadian Electric Railway Statistics.

The returns of electric railways in Canada show that there are 767 miles of such in operation in the Dominion. The capital invested in them, including Dominion and Provincial subsidies and municipal aid, was $80,453,609, being an increase of $1,219,932 over last year. Working expenses were represented by the sum of $5,326,517, an increase of $853,659, when compared with the previous year. Net earnings were $3,125,092, or an increase of $366,273. There were 181,689,998 passengers carried, as against 155,662,812 for the preceding year.

The Traction Dinner of the Institute.

AN account of the successful annual dinner of the American Institute of Electrical Engineers, held on February 8, was given in the last issue of ELECTRICAL WORLD AND ENGINEER. The dinner was devoted to the triumphs of electric traction, so that the speakers and speeches had all a specific relation to that subject. In addition to the speeches, the exercises included, as previously noted a biograph exhibition of electrical manufacturing, of the Subway in operation, and of the new New York Central locomotive competing with steam locomotives; while a splendid photograph of the assemblage was taken by means of the Cooper-Hewitt mercury vapor light. Among the telegrams received was one from Mr. T. A. Edison, who said: "Hearty congratulations and good wishes to the Institute, and to my fellow members who have worked in the field of electric traction. Our efforts must not cease until electricity has made the whole art of transportation fully and forever its own." Mr. George Westinghouse also sent a dispatch from Pittsburg and Mr. W. B. Potter telegraphed from Schenectady.

President Lieb delivered a brief salutatory, in which he reviewed the history of electric traction here and abroad, citing particularly the names and work of members of the Institute, such men as Daft, Edison, Field, Short, Van Depoele, Henry, Bentley, Knight, Mailloux, Arnold, Scott, Potter, Condict, Reckenzaun, and added: "It is, however, to another characteristically American inventor and pioneer to whom belongs the honor to have first demonstrated that the electric railway could be made to do something more than afford an interesting demonstration of the potency of electric power and the possibilities of electric transportation—a man to whose ability, courage and perseverance we owe the demonstration on a large scale of the practicability of electric traction. I refer, of course, to our honored past president, Frank Julian Sprague. (Great applause.) It required indeed a rare combination of those qualities which are characteristic of American engineers and American engineering methods—audacity, skill, perseverance and a strongly developed commercial sense—to have undertaken in 1887 the contract to electrify a complete railroad system of thirteen miles of track and twenty cars, and that, too, with the natural difficulties which the Richmond road presented.

"Developments from 1887 to date in the application of electricity to traction purposes were so rapid that to attempt a chronological recital would carry me too far afield, and to merely mention the names of those who subsequently co-operated in this great work would be like counting the stars—the Institute catalogue of membership is crowded with them. The impulse then given to electric traction has carried us ahead of all other nations in this field of engineering activity, and has done much toward securing to electrical engineering, and to this Institute, the eminent position which it holds to-day in the engineering world. Such results are not accomplished without great personal sacrifice and become possible only through the co-operation of many individuals. All honor, then, to those valiant pioneers who, at the sacrifice of labor, brains and fortune, have accomplished this great result, and who have done so much toward advancing the profession of electrical engineering."

The toastmaster, Mr. T. C. Martin, said that the beginning of modern electric traction had found one of its most illustrious representatives a modest ensign in the United States Navy, which then consisted of 250 admirals, 50 ensigns and the president's private yacht. Such conditions soon drove the juniors ashore as lieutenants. The less scrupulous went into Tammany, journalism, consulting, and technical education; the more deserving became inventors. One of them, able to leave no tracks on the pathless waste of sea tried what he could do with terra firma, and had never been at sea since. The study in the long watches and dreary nights afloat soon had its fruition in some of the most brilliant and spectacular achievements they were now celebrating—due to the genius of the Edison of electric traction—Frank Julian Sprague.

Mr. Sprague, who was most enthusiastically received, made an admirable speech, reviewing "The Art and the Men," traversing some of the ground touched on by Mr. Lieb but advancing also some views and opinions as to present conditions. His generous eulogy of old associates and keen competitors was very much appreciated. He told some graphic stories of struggles connected with the historic Richmond road. Mr. Sprague then touched on conduit and elevated railway operation, and referred briefly to the evolution of the multiple unit system, whose potentiality had added at least $15,000,000 to the

value of the Subway. He then came to a consideration of trunk line work, and said:

"We stand in the midst of the solution of grave and complicated problems, incident to the demands of our local situation. Terminal improvements on the New York Central, Pennsylvania and Long Island railroads, costing nearly $80,000,000, and made possible chiefly because of electric traction, supplementing the equipment of the surface, elevated and underground railways, may well dazzle the mind, and lead to hasty conclusions, forgetting that in so far as these problems are out of the ordinary they are many of them special in character.

"Our esteemed Senator, Mr. Depew, has been quoted recently as saying that in ten years the only place for a steam locomotive would be a museum. Is the wish father to the thought, or does it mean the awakening of our railway officials to the possibilities of the future? If so then we indeed have reason to congratulate ourselves, for there is much work ahead. But, gentlemen, let us be in no hurry to build museums, for in spite of any development which may take place, our old friend the steam locomotive will be on deck and doing business at the end of another decade, although his younger brother will be giving him an interesting tussle. We have indeed 30,000 miles of line to the credit of the electric railway in this country alone, but the character of the traffic and the service performed by these lines is absolutely distinct from that pertaining to trunk line operation. Two hundred thousand miles of road, and over half a million miles of track are in its grasp—a prize worth fighting for, but not easily won. Understand, I do not for one moment take the position that a railroad, no matter how large, cannot be operated electrically. It can be. Energy of that amount can be transmitted for any distance commercially required. Motors of large power and aggregated into combinations of capacity greater than that of any steam locomotive can be built and perfectly controlled.

"And with great power there is, of course, the possibility of high speeds, but a well-ballasted track, free from curves, grades and grade crossings, a reserved right of way, perfect brakes and signals, infrequent stops, and favoring outward conditions are equally essential to steam or electric traction of the first order. It is sustained, not extraordinary maximum, speed which is required in practical service, and sustained speed is a matter of finance."

The toastmaster then introduced Mr. Leo Daft, as follows: "One of the greatest churches in Christendom has an inflexible rule that no man shall be eligible for canonization until fifty years after he is dead. It is assumed that if the truth does not come out in that period his sanctity is established. We electricals naturally have different ideas of acceleration, and take the shorter cut. We canonize our saints and heroes just as soon as their patents run out, and we have no longer to pay them royalties. (Laughter.) So long as the seventeen years hang over us we look at them with scorn, contumely and contempt. We flout them. We swear at them, and we swear back of their earliest dates (laughter); and then the term having expired, a gold medal and an Institute dinner await them, whereupon we clean the slate. The Tesla patents running out this year, it is quite possible that we may have a dinner on that account next year, when the toastmaster would be proud to resume his functions. (Applause.)

"It was known that fortune was a jade, distributing her favors unequally, long before electrical inventions and discoveries came to the creation of illimitable wealth. In that wealth we electrical inventors—and am I not a journalist, and do I not invent? (laughter)—participate, but we receive a very small share and proportion of her favors, so that if all of the wealth which comes to electrical inventors were rolled into one pile, not one of us would die creditably disgraced. In due time, however, recognition and rewards of the higher kind come, and thus we are seeking to-night to pay a tribute of esteem and respect to one of those who did splendid and brilliant work in the traction field before this Institute came into existence. These twenty years have dealt lightly with him, and I know he will deal light with them. As I look at our esteemed friend in his virile comeliness, so typical of the handsome English race from which he springs, I am glad to extend your congratulations and my own to that worthy pioneer, Leo Daft, who will address us on 'These Twenty Years.'"

Mr. Leo Daft regretted that he was limited to ten minutes, as that was only half a minute per year, hardly a liberal allowance for such stirring events as they were commemorating. He said:

"It seems almost incredible that the crude apparatus and machinery of those days was made to accomplish what we find on the records. But many of those who are gathered here to-night can have but a faint idea of the incessant labor and personal sacrifice involved in the effort, often, alas! unsuccessful, to maintain a reasonable schedule on the roads then in operation."

Mr. Daft then reviewed interestingly some of his own early work, notably that at Mt. McGregor-Saratoga in 1883, at Baltimore, and on the Manhattan elevated. Looking back over the twenty years he was struck with the encouraging attitude that New York had maintained toward the new art and industry. "There was an almost total absence of deadly neglect or active opposition." * * * "Perhaps the best feature of this substantial aid was the fact that it was accompanied by the good-natured restraint which keen business judgment imposed upon the often dangerous enthusiasm of the inventors themselves." In conclusion, Mr. Daft referred feelingly to the youth of the men he saw around him, as a good augury for the growth and future of the art to which he had given his life.

The toastmaster then said: "The City of New York and this region can certainly claim to have given its public the cheapest, best, swiftest, the most comfortable transportation that was ever enjoyed by any population on the face of the globe, and we are proud to have around us and among us to-night the men who are handling these great systems. In spite of this fact this city remains the greatest horse railway centre in the world, for in a report which I recently saw in German I observed that the gentleman on my right (Mr. Vreeland) was referred to as being the manager of the largest Pferdestrasseeisenbahnwagensysteme (laughter). Mr. Vreeland began his career in the transportation business very early. Like most parsons' sons he soon got into mischief. His training was simple and adequate, beginning with the distribution of congealed Hudson in cubical blocks to perspiring consumers. We next find Mr. Vreeland superintendent of a gravel train on the Long Island Railroad, a training which certainly equipped him for dealing with the New York public. I mentioned this fact to a 'grouty' fellow passenger one day during a blockade, and he said he always suspected it. To this day the Vreeland personally conducted dirt excursions are hallowed memories on Long Island. It was natural that a man with so much sand should abandon a place where sand was a superfluity, and that with a transfer across the Brooklyn Bridge he should have found his career and destiny in New York City. Since his arrival we have discovered in him not only a benefactor but a director of the finest school of all the moral virtues that are known in this country, as exemplified in the New York City Railway system. The Vreeland aphorisms with regard to street railway traffic have become as familiar in our mouths as household words: 'A car ahead is worth two in the barn,' 'Stepping lightly cures cold feet,' 'Each car knows its own schedule,' 'Every corner is acquainted with its own bitterness,' 'A nickel collected is two earned.'

"I could present Mr. Vreeland in a far more attractive light than I have already done, but I think I can sum up all his attributes and evidence the high opinion which his fellow citizens of New York hold of him when I inform you that at the recent celebrated dinner of the National Civic Federation, he was made chairman of the Seating Committee (laughter).

Mr. Vreeland, who was very warmly received, said: "My good friend, the toastmaster, has taken this means of introducing me to get square. He used every endeavor to get me to take a seat on this rostrum in the earlier part of the evening. In the Civil War, in one of the engagements, General Lee found a man rushing to the rear ranks. He stopped him, and said, 'What is the matter my man? Get up front! get up front!' The man answered, 'General, I have been up there, and it is a place to which no self-respecting man will return.' (Laughter.)

"Mr. Sprague, in his speech, wanted you to infer that he was describing electrical conditions at the time when he started to operate an electric road. He did not refer to the electrical situation in New York a couple of weeks ago. In my opinion, there really has been very little advance in the electrical art as evidenced by the conditions which existed in and about this city a short time since. Sprague and his confrères gave us the broomstick train, and devoted all their energies and genius to perfecting it. It was left for æsthetic New York to demand something superior to that; but how satisfactorily it operated a week or two since I am not saying much about, as I may be held responsible for the difficulty, although it was entirely electrical. Trolley transportation work from a managerial standpoint, in and about the great city of New York, is one of the most difficult problems that has ever confronted managers of the various properties

which are operated in the territory in and about the city. They are called upon, speaking of transportation facilities as a whole, to move some 700,000,000 of people a year in Manhattan and The Bronx, and over 1,000,000,000 of people a year in the territory comprised within Greater New York. The problems connected with that are vast and of the greatest importance to the well-being and the orderly conduct of affairs of Greater New York. We who are operating electrical railroads want electrical engineers to stop and give us a chance to catch up. We have entirely too much to do with the possibilities of the future and cannot give enough thought to the practical side of the daily questions that confront us. In all my experience in steam transportation I never had builders of locomotives attempt to cure the ills of the apparatus I was operating by telling me of something better I could buy. (Laughter.) There was always an earnest and consistent effort to make what we had operative, and leave the new things for a new order of affairs."

Mr. Vreeland then made an eloquent presentation of the work done by electricity in promoting intercourse and communication not only by the broomstick train but by the telegraph, telephone and other agencies.

The Toastmaster: "Tunnels in New York history have been largely hitherto associated with beer and other gaseous compounds. We are changing all that, and the tunnels we now have are among the proudest monuments that New York can boast. It can be claimed with truth that the New York Subway is simply and literally 'out of sight'—for fifteen miles—and that although it has cost a great deal of money it does not come high, except at the Manhattan Viaduct. We were at first at a loss to determine what it might be. We know that for four years New York by it was run 'wide open'—forty feet wide open, one hundred feet deep. But now the tunnel, like the police, has become one of our greatest moral forces—it has deprived the resident of the northern end of the island of his last excuse for being home late to dinner. Whether it was a railway or mine we were not able to determine. We now know that it was a gold mine, out of which the quartz has been taken in buckets, and from which, from time to time, the water is withdrawn by fire hose. If we suffer, also do we gain. We have all been wondering where the dividends came in on the suffering. Now we know, because, according to the latest returns, any subscriber—I mean sufferer—who took up a block of $40,000 worth of stock in the Interborough can today point to his cross of gold in the shape of a profit of $75,000. Evidently there have been some admirable picks and pickings in Interborough, but the picking which to us seems the most commendable, is that which secured for the system the selection of its electrical director. The success of the system is largely dependent upon one man, and I have much pleasure in introducing him to you, Mr. Lewis Buckley Stillwell, who will address us on 'Traction Above Ground and Under Ground.'" (Applause.)

Mr. Stillwell, in opening his remarks, expressed his regret that Mr. August Belmont himself could not have been present to enjoy their eulogies and comments as to the Subway. In regard to the underground road, Mr. Stillwell said:

"We have learned from the newspapers that it has its defects. Notoriously, it is full of microbes. It is said that they are present in such numbers that the rails are fairly greasy and the wheels of the cars are sometimes seen to slip. The atmosphere of the Subway is a mixture of CO_2 and H_2S. There is practically no oxygen present. It is so noisy that even the loudest advertisements that have been secured by the efforts of the celebrated art collectors (who have collaborated so earnestly with the architects in decorating the stations) cannot be heard when trains are passing. It is infested by myriads of rats, which, by means of this dangerous subterranean channel of communication, make their way in droves from one part of the city to the other, carrying with them pestilence and famine. We all know that the deadly third rail is employed, and I may as well admit right here and now that the company's engineers have obstinately refused to adopt and utilize scores of plans for rendering the third rail innocuous. The weight and speed of the trains are such that people standing upon the tracks are liable to be seriously hurt, and the dangers of flood and fire are so imminent that the company should be compelled to issue an accident policy with every ticket. The electrical equipment is all wrong. Nothing, not even ignorance, will excuse this, for some of our most popular inventors at high frequency during the last decade or so have announced even in the columns of the daily press, inventions which they were about to make which would have made it possible to avoid all these mistakes.

"Having admitted frankly some of the many defects of the Subway and the failures of the engineers responsible for its equipment, I desire to say a few words in all seriousness regarding certain facts which have been demonstrated by the electrical equipment of the elevated lines and the construction and equipment of the Subway. As a public work the construction of the New York Subway has been an object lesson of great significance and value. From start to finish it has been carried out under the direction of the Rapid Transit Commission, without fear or favor, and with an eye single to the public good. No money has been wasted and not the slightest scandal of any kind has attended its progress. The work is a splendid monument to the Commission and to its engineers. The community has received maximum benefit at minimum cost. At the same time the enterprising men who ventured their capital in the enterprise, at a time when its success was generally considered doubtful, have reaped a handsome reward to which they are in every sense of the word entitled. As a railway, the subway demonstrates the value of the four-track system with island platforms. This system makes it practically possible to double the speed which can be attained if two tracks are used. Doubling the speed means doubling the distance at which the average man may locate his residence with respect to his place of work, and, as has been pointed out frequently, doubling the distance means quadrupling the area within which men working in a certain business district can locate their homes and plant and cultivate their own individual vines and fig trees. Every north and south subway hereafter constructed on Manhattan Island should have four tracks—not less—and so far as practicable this rule should be applied in the case of tunnels running east and west, except perhaps those sections which are beneath the rivers. Two-track systems having three or four stations per mile can never secure rapid transit in the sense to which that term is properly limited in such a city as ours.

"As regards equipment, the Subway has demonstrated in the sight of all men the fact that trains weighing 320 tons can be driven by electric power at a speed of 45 miles an hour between stations, and that electric equipment can develop a tractive effort of 45,000 lbs., which is far more than double the draw-bar pull of the average passenger locomotive."

The Toastmaster: "One of the gentlemen who has addressed you this evening spoke recently to his son, commenting on his mechanical ability, and asked him as to the career he would like to follow; and suggesting that electricity offered him the best opening. The youth, with the disdain of his age and that average American idea that any art or business is thoroughly exhausted in one lifetime, said he would rather get into something new. His father pointed to wireless telegraphy whereupon the youth rejoined that he could see 'nothing in it,' and he was sure nobody else could see anything in it or of it. Here again we have misconception—something like that of an old spur climbing friend of mine who besought my help in getting a position as lineman with a wireless company. He had been accustomed to political jobs. I shall never forget the disgust with which he came back and said that the blamed thing had more 'wires' about it than anything he had ever struck.

"We are shortly to be represented in Europe in connection with a wireless telegraph conference by one of our most distinguished Americans. I have often thought it would be well if more of such men could go abroad, and if our foreign friends could get in touch with more of our great men. One step toward a better appreciation of us in Europe and among Europeans is such a visit as General Greely is about to make, for certainly one who has toyed with Arctic icebergs will find absolutely no difficulty in carving the ambient atmosphere into nautical bailiwicks. (Laughter.) I have much pleasure in asking General Adolphus W. Greely, Chief Signal Officer of the United States Army, to address us on 'Other Uses of Electricity.'" (Applause.)

General Greely made an admirable address on the topic assigned him, referring more particularly to the work of the Government in submarine cabling and in wireless telegraphy,

This brought the speaking to an end, and shortly after 12 p. m. President Lieb thanked the dinner committee for its admirable work, and declared the incident closed.

Herewith is presented as a supplement, on extra quality paper, a half-tone reproduction of the special photograph of the assemblage taken in 20 seconds by the aid of Cooper Hewitt mercury vapor light. Twenty of these tubes were employed, at a height of about 20 ft. from the floor, and at an average distance of 7 ft. apart. Some of the lamps were 40 ft. in height. Eighteen of the lamps were horizontal, two were vertical to the speakers' table.

Electrical Engineers of the Times.—VII.

H. P. MAXIM.

Hiram Percy Maxim was born September 2, 1869, at Brooklyn, N. Y. Mr. Maxim represents the fourth generation of inventors and engineers bearing the Maxim name. His father is Sir Hiram Maxim, the eminent inventor, now a naturalized Englishman. After his common school education in Brooklyn Mr. Maxim entered the Massachusetts Institute of Technology at Boston, where he took a mechanical arts course, graduating in 1886, the youngest member of his class.

After graduation he took a position with the late H. M. M. Slattery, then engaged in developing alternating-current lighting apparatus for the Sun Electric Company, of Woburn, Mass. After a year's experience in experimental work, as an assistant, he was offered a position by the Fort Wayne Jenney Electric Company, in Fort Wayne, Ind., which was at the time organizing its incandescent lighting department. Here as draughtsman he remained for nearly another year, when receiving an offer from the W. S. Hill Electric Company, of Boston, and wishing to return to the East, he resigned and joined the Boston company. Taking up the designing of small motors and switchboard work, he assisted in the development of much detail electrical apparatus which is standard to-day. After two years with this company an opening developed

H. P. MAXIM.

with the Thomson Electric Welding Company, at Lynn, Mass., which he accepted. Here he was a designer and mechanical engineer, having direct charge of work in some of the many new fields into which electric welding was at that time being introduced. Among them was the welding and bending of pipe and the welding of projectiles for heavy ordnance. In each of these fields apparatus and methods were developed with enough success to lead to the formation of separate companies to work each commercially. The Electric Pipe Bending Company took the pipe work and the American Projectile Company took up the projectile work. Mr. Maxim was made the superintendent of the latter company and given direct charge of the mechanical engineering development. Success rewarded the effort and the company and its successor, the American Ordnance Company, enjoyed a large share of the ordnance work of the United States Government. It finally absorbed entirely the works of the welding company in Lynn, its parent.

In 1894, while superintendent of the projectile company, and doubtless as a result of studying torpedo propulsion problems, Mr. Maxim became interested in road vehicle propulsion. In those days a motor-propelled road vehicle was unknown in this country. After making several valuable determinations on vehicle traction questions he built a three-cylinder, air-cooled gasoline tricycle, which closely represented some of the best types of automobile vehicles of to-day. This work he carried on at his own personal expense, and at the time it attracted considerable attention. Among others, Col. A. A. Pope became interested, and finally made an arrangement with Mr. Maxim whereby he resigned his position with the projectile company and joined the Pope Manufacturing Company in Hartford. Here, although but a young man, Mr. Maxim for the fourth time took up the development of an entirely new class of apparatus.

His success in this effort is well known. In 1896 he produced the first standard Columbia electric motor carriage. It is no small credit to him as an engineer that these first electric vehicles hold their place at the front to-day for excellence and permanence. In the years following the development was very rapid and finally resulted in the formation of the Electric Vehicle Company, which is in existence to-day and of which Mr. Maxim is the chief engineer. The number and variety of both electric and gasoline-propelled vehicles which have been produced under his direction is probably unequalled, and he is generally recognized as one of the pioneers in the industry.

Mr. Maxim is the author of a number of technical papers and his services as a lecturer have been much in demand by automobile clubs. He is a member of the American Institute of Electrical Engineers.

CURRENT NEWS AND NOTES.

TELEPHONE REDUCTION.—The New York Telephone Company has announced a general reduction of 25 per cent. on all its charges for service in the various departments of the municipal government, effective from January 1, 1905.

COMMERCIAL CABLE.—Nearly a hundred employees of the Commercial Cable Company participated in the annual banquet of the system on February 11 at the Hoffman House. There was speaking, accompanied by vaudeville, songs and stories. A most enjoyable time was spent.

A. I. E. E. MEETING.—The February meeting of the American Institute of Electrical Engineers will be held in the chapter room, Carnegie Hall, 154 West Fifty-seventh Street, New York City, Friday, February 24, at 8.15 p.m. The following paper will be presented and discussed. "Two-Motor vs. Four-Motor Equipments," by N. McD. Crawford, general manager of the Hartford (Conn.) Street Railroad Company.

LORD KELVIN will be the recipient of the first John Fritz gold medal awarded by the joint committee of the four national American engineering societies under the deed of gift to the man most representative of and eminent in scientific advance in the engineering field. This medal was founded three years ago on the occasion of the eightieth birthday of John Fritz, the famous inventor and engineer in the iron and steel industry, who is still alive, hale and hearty at Bethlehem, Pa.

THE SIMPLON TUNNEL.—A cable dispatch from Geneva, Switzerland, of February 11 says: "Under ordinary circumstances, the colossal undertaking of the last Alpine tunnel should be completed this summer. Great preparations are being made on the side of Italy for the opening. Rails and sleepers are stocked on the sides of the tunnel, and they will be laid as soon as possible. Telegraph and telephone wires will also be laid in the tunnel, and those passing over the mountains to Italy will be taken down. All the branch lines joining the Simplon have been completed, as also the numerous stations."

MECHANICAL RECTIFIER FOR ALTERNATING CURRENTS.—One obstacle to the use of commutated alternating currents has been the fluctuating character of such current. By employing polyphase currents, the fluctuation is reduced greatly as compared to single-phase currents, but it is still too great for many uses. If three-phase currents are commutated in the ordinary fashion, the resultant rectified current fluctuates about 15 per cent. In a patent granted February 7, 1905, to Mr. T. Bodde, it is suggested that by combining two sets of three-phase currents displaced by thirty degrees the fluctuations may be reduced to less than three and one-half per cent. The displacement of phase between the two sets of three-phase currents is obtained by a combination of delta-star transformations from a single polyphase source. Two synchronously-driven commutating devices, series connected, serve to add up the fluctuating e.m.f's so as to give a fairly constant sum. Numerous schemes involving the use of aluminum cells or mercury vapor tubes are proposed for the preventing of sparking.

INCREASING USE OF RUBBER.—The growing demand for India rubber for use in manufacturing in the United States is illustrated by some figures just presented by the Department of Commerce and Labor through its Bureau of Statistics. They show that the value of India rubber imported into the United States has grown from $10,000,000 in 1884 to $44,000,000 in 1904, and that the total value of India rubber imports in the period 1884-1904 is, in round terms, about $440,000,000. This increase in the value of rubber imported is due in part, however, to an advance in price, the average value per pound of the imports of crude rubber (including gutta-percha) having been in 1884 43 cents, and in 1904 70 cents. The total quantity of rubber imported in a crude state in 1884 was 23,672,563 pounds, and in 1904 61,889,758 pounds.

CIRCUIT-BREAKERS FOR MULTIVOLTAGE CIRCUITS.—For the purpose of protecting the generating equipment in multiple-conductor systems, it is desirable to place overload circuit-breakers in each lead. A patent issued February 7, 1905, to C. W. Stone relates to means for causing all breakers of any set to operate simultaneously when a single one is overloaded. Each circuit-breaker is provided with two tripping coils, a main and an auxiliary and with a circuit-closing device which operates upon the tripping of the circuit-breaker. All of the auxiliary tripping coils are connected in series, the circuit from a source of current being completed through the various circuit-closing devices at the breakers. When one breaker opens, from any cause, all of the auxiliary tripping coils are energized, thereby causing all of the remaining circuit-breakers to trip.

RADIUM IN FRANCE.—A cable dispatch from Paris of February 4 says: "Pierre Curie and his indefatigable wife and scientific colleague predict splendid results from the discovery of a radium mine near Issy l'Evéque, in the Department of Saône-et-Loire, fifty miles northwest of Lyons. M. Curie's reports on the new discovery have been approved by the Academy of Science and Exploitation and of Mines, and the extraction of radium is proceeding satisfactorily. M. Curie says that now there are only a dozen grams of radium in existence among all the laboratories of the world. Characteristic of the radium mine near Issy l'Evéque is that this is the first time pitch-blende containing radium has been found without any trace of uranium, which hitherto has been supposed to be the real generator of radium. Consequently this discovery, besides being most important from an economical standpoint, upsets many preconceived ideas of this mysterious metal."

MUNICIPAL OWNERSHIP IN CANADA.—It is stated that the extent to which municipal ownership has been discussed in Canada, more particularly in view of the municipal elections, was a notable feature during November. The municipalization of the railway systems of Toronto and Ottawa was proposed, an offer of the stock being made by the company in the latter to the city council for $2,500,000. The purchase of the Hamilton street railway by the municipality was also proposed. In connection with gas and lighting plants the city council of Westmount, Montreal, decided in favor of taking over and operating the local electric lighting plant, and the question will be presented to the ratepayers in December. Final arrangements were made for the purchase of gas stock to the amount of $1,000,000 by the municipality of Toronto, as sanctioned by the ratepayers. The municipality of Calgary has decided to invest $60,000 in a lighting plant. In connection with the negotiations at St. Thomas, Ontario, for the purchase by the municipality of the plant of the local gas and electric light company, the experts engaged in valuing the plant came to a decision in November, the sum named being $196,366. The establishment of a municipal telephone system was discussed at Whitby, Ont., which is now supplied with a system of waterworks, light and power.

ELECTRIC INGOT EXTRACTOR.—A patent issued February 7, 1905, to J. R. Speer and W. H. Baltzell relates to electrically-operated mechanism for stripping ingots from moulds. In its preferred form the complete mechanism consists of an electric traveling crane, the novel features residing in the devices which are substituted for the usual load-engaging and lifting hook. Combined with the hoisting equipment is a plunger arranged to be forced against the upper, smaller end of the ingot, which it holds in place while the mould-engaging devices or links draw the mould away from the ingot. The travel of a few inches is usually sufficient to accomplish the separation of the mould from the ingot, after which the traveling crane is used in the familiar manner. The flexibility of the system, rapidity of operation and ease of handling are the principal advantages over other similar hydraulically-operated strippers. Another patent of the same date granted Mr. Baltzell has for its object to simplify the disengaging mechanism of the stripper. For this purpose the inventor so designs the lifting gear that the gravitational force exerted by the mould and ingot acts through the medium of the lifting cables and sheaves to cause the plunger to be pushed downward upon the top of the ingot, and the mould to be lifted upward with a force sufficient to separate the two. The number of times the cables are wrapped about the sets of sheaves will depend directly on the force for separation and inversely upon the weight of the ingot and mould.

TREES AS WIRELESS TELEGRAPH ANTENNAE.—Attention has been called in these columns to the work of Major G. O. Squier, U. S. A., in using the sap of trees as a current-conducting medium. A patent granted to Major Squier on February 7, 1905, relates especially to wireless telegraphy. There is no more intimate connection between earth and air, both of which are essentially involved in wireless telegraphy, than is found in growing vegetation, which in fact lives and grows from the constituents of both. The inventor states that the surface of leaves elevated from the surface of the earth acts in much the same manner as conducting plants for electromagnetic waves, and can be charged and discharged in the same general way through the conducting cells and juices throughout the structure. The root system seems to insure a good conducting space around the base of such an antenna to a considerable radial distance and conduces to keeping the surrounding earth bed in a moist and therefore good conducting state for electric waves. Of the seven claims allowed in the patent, two read as follows: In wireless telegraphy means for shunting a portion of the electromagnetic waves absorbed by living vegetable organisms, through a branch electric circuit and a suitable receiving device operated by the waves thus shunted. In wireless telegraphy an antenna or aerial containing as a part of its electric circuit, for absorbing, emitting and conducting electromagnetic waves, the branch and leaf system of living vegetable matter.

THE CHICAGO TUNNEL.—With regard to the recent attempt of labor leaders in Chicago to prove fraud in connection with the Chicago telephone and traction tunnel, the New York *Times* says: "Nobody should be surprised to learn that the labor leaders of Chicago are much wrought up by the existence and operation of the subway in that city, nor that they have sought the indictment of its promoters. Surprise is a more legitimate emotion at the announcement that they have succeeded in obtaining an indictment. Mr. Wheeler, the head and front of the project, is a promoter of great enterprise and imagination. He foresaw the huge economies that would be effected by the operation of all the heavy traffic in the business district of Chicago under ground on electric cars instead of by trucks on the surface. His success in obtaining the hearty adhesion to his project of the business men was in great part due to their exasperating experience with the truckmen, and the frequent and ferocious "labor troubles" that arose. The opportunity of dispensing altogether, or in great part, with the services of the truckmen they accordingly hailed with delight. Naturally the prospect was not hailed with equal delight by the truckmen themselves whom it was proposed to dispense with, nor yet by the labor leaders who designed to get their own livings out of the truckmen's wages. One of the advantages of the subway is that it is physically unassailable by riotously disposed labor. A color of legality is necessary in order to put it out of business. No wonder one of the labor leaders is horrified by the crime of the men "who have been stealing a sub-Chicago under our very feet." If the subway company has really acted unlawfully, of course it will have to bear the penalty. But it remains true that it has conferred a vast benefit upon Chicago, and that, after its illegalities, if any, have been corrected, Chicago will have reason to be grateful to its promoters, instead of prosecuting them. Not the least of its public services is the release of the community from the tyranny of a particularly tyrannical trades union."

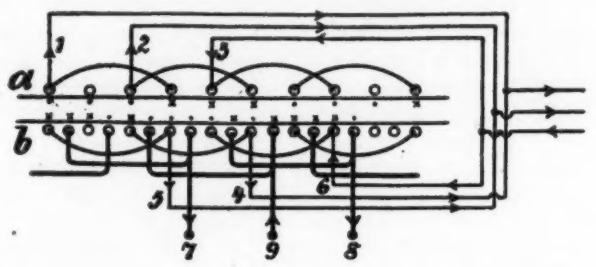
DEVONPORT'S ELECTRICAL DOCKS.—Mr. Joseph G. Stevens, United States Consul at Plymouth, England, writes: "Considerable progress is being made with the new electric power generating station at Keyham, and so far advanced is the work that cables to the various buildings in the Government establishments at Devonport and district are already laid. When the work is completed there is to be a thorough transformation of the motive power of the machinery now used in the yard. The present locomotives will be superseded by electrically worked trains; all the machinery, in fact, will be worked by electricity. A part of the new scheme will be the readjustment of the present scale of working hours. When the electric lighting is established there will be a uniform working week of forty-eight hours."

THE LATE GEORGE S. BOWEN, of whose death we made note in our issue of February 4, was an interesting and typical Western figure—cheery, optimistic, realistic, visionary and restless—a man of pure character, high ideals and ceaseless activity. As already noted, he was the father of the National Electric Light Association, which as the result of a call issued by him met and organized in Chicago in February, 1885. He was deservedly made an honorary member of the body in 1890, and never ceased to take an interest in its growth and prosperity. His later years were spent at Elgin, Ill., of which city he was one of the oldest and most progressive residents. In his youthful days he was a leading citizen of Chicago, but the great fire wiped out millions of property in which he had a large stake. As far back as 1879 he advocated and promoted reciprocal trade with Mexico.

SEVERE SOUTHERN STORM.—The wind and sleet storm in the South last week was more destructive than was at first reported. A special messenger dispatch from Atlanta, Ga., of February 9 says: "Atlanta is cut off from the rest of the world by wire communication, both telegraphic companies being without a wire to points beyond the limits of their operating rooms. Several thousand telegraph poles are down around Atlanta. Besides the damage to wires, the loss of shade trees in Atlanta has been enormous. The ice-laden branches have broken, delaying or stopping street car traffic, lighting and telephone communication within the city limits. Six thousand telephones are reported out of use. The isolation of Atlanta has been intensified by the delay to the traffic by team from country points, and prices of produce have risen to almost prohibitive figures. Supplies of staples are normal." Advices from Louisville, Ky., say under date of February 9: "The telephone companies in this vast arena have been practically out of business since last Saturday night. The telegraph lines are in but little better condition."

TELEPHONE CABLES.—In a recent lecture on telephony, Mr. C. J. H. Woodbury said: "The first telephone cables, both aerial and submarine, are believed to have been those used at Philadelphia in 1881, and at that time experimental constructions were being made at Providence, Brooklyn and Boston. In the latter city parallel rubber-covered wires, giving conditions of such great electrostatic capacity that a mile was the utmost limit of telephonic transmission, were tried, but when about a third of a mile was inserted in a telephone line subscribers complained that their instruments were becoming worn out, as they could barely hear; and the induction between the parallel wires was so great as to transmit cross talk between the various circuits. The induction was stopped by placing the wires in twisted pairs, but the problem of insulation with a low static capacity required long experimentation by many persons. Mr. W. D. Sargent, of Brooklyn, tried paper insulation and found that the static capacity was reduced and the transmission correspondingly improved, which Mr. T. D. Lockwood found to be due to the occluded air among the loosely twisted fibrous paper, and not to the paper as an insulating material. Mr. John A. Barrett, of New York, was intimately engaged upon experimentation and manufacture of cables, and to him are due many improvements in cable design. At this time Mr. W. R. Patterson, now of Chicago, was working along independent lines, and made a form of hydraulic press for drawing on the lead cable sheath, which is still in use as the standard method of manufacture, although many changes of detail in the conductors have been introduced, with the result of improving telephonic transmission to over five times that of the first cables using twisted pairs."

SELF-EXCITING INDUCTION GENERATOR.—The frequency of the current in the secondary of a polyphase induction motor is equal to that of the primary multiplied by the slip of the rotor from synchronism. There are two rotor speeds at which the primary and secondary frequencies become equal, zero speed and double synchronism. At either of these speeds there may be obtained from the secondary winding a current equal both in frequency and e.m.f. to the primary current (on the basis of a 1 to 1 ratio). According to a patent issued February 7, 1905, to Emil Ziehl, it is now proposed to utilize this property of the induction motor to produce a self-exciting alternating-current generator. On the core on which the primary winding is placed, the inventor winds a second coil spaced 90 electro-mechanical degrees from the primary coil.



In this second coil will be generated an e.m.f. equal at all times to the primary e.m.f. (1 to 1 ratio) both in value and frequency, but displaced from it by 90 electrical time degrees. The inventor connects together both this second coil on the primary core and the secondary winding of the machine, the intention being that the current which flows through one coil will be equal in magnetomotive, opposite in phase and mechanically so located that the resultant magnetism due to the two currents will be of zero value, and hence will not affect the main primary field. The connections are shown in the accompanying illustration, in which 1, 2, 3 are the secondary winding, while 4, 5, 6 and 7, 8, 9 are the two windings on the primary core. It is stated that the actual exciter winding, 7, 8, 9, can be supplied with current from the three-wire network connected from 1, 2, 3 and 4, 5, 6, so that the machine becomes a self-exciting generator. It will be interesting to analyze the internal reactions of this machine and to determine its characteristics.

ASYNCHRONOUS MOTOR WITHOUT PHASE DISPLACEMENT.—A machine which is properly termed by its inventor a "polymorphous dynamo" forms the subject of a patent issued February 7, 1905, to H. A. E. Harlé, of Paris, France. The rotor has two windings; one, supplied with a commutator and similar in all respects to that of a direct-current generator armature, and another supplied with slip rings and similar in all respects to that of a polyphase alternating-current generator armature. On the stator are placed two windings, one closed upon itself and similar in all respects to the squirrel-cage secondary of an induction motor, and another having polar-wound coils and similar in all respects to the induction winding of a polyphase motor. The machine can be used as a motor, either synchronous or asynchronous, with or without phase displacement, between current and e.m.f., as an asynchronous generator supplying its own excitation, as a rotary converter or frequency transformer, or as an exciter for alternators. In its use as a motor polyphase alternating current is supplied to the rotor through the slip rings, the revolving field thus produced causing the rotor to gain speed on account of the closed secondary winding. On the commutator of the rotor there are placed certain brushes equal in number to the number of phases of the polar-wound stator coils. The e.m.f. generated between these brushes will have a frequency depending directly upon the slip of the rotor from synchronism, and a time-phase position depending upon the mechanical position of the brushes. Since the frequency of the current in the secondary (stator) winding likewise varies directly with the slip, current of the proper frequency, and any time-phase position can be obtained from the above-mentioned brushes, so as to supply the magnetomotive force for the field excitation, reducing the primary wattless current to zero value or causing the current to become leading. The theory of operation is similar to that of the well-known Heyland asynchronous machines, though the mechanical construction is essentially quite different.

The Westinghouse Single-Phase Railway System in Operation.

THE first electric railway in this country to place a single-phase electric traction into regular commercial operation is that of the Indianapolis & Cincinnati Traction Company. This company has adopted the Westinghouse single-phase railway system, and the first car equipped was put in service December 30, 1904; on January 21 regular service with the system was opened between Rushville and Morristown, two points 16 miles apart.

The Indianapolis & Cincinnati Traction Company was organized for the purpose of building a double-track through line from Indianapolis to Cincinnati. At present the line has been constructed between Indianapolis and Rushville, a distance of 41 miles, and a through service between these towns has been established. At an early date the road will be extended to Connorsville. In all the smaller towns a private right of way has been obtained, and the road is not constructed upon streets or highways except in cities or towns of such size as to make it necessary. In all cases sharp curves are avoided and such an alignment has been secured between cities and towns as will permit of very rapid running with entire safety to passengers and equipment. In most instances right of way is protected by a woven wire fence, erected under an agreement with the land owner, whereby the latter maintains the fence and keeps all its gates closed. Wherever such an agreement was not secured, the right of way is fenced with barbed wire. The company obtained entry into Indianapolis over the tracks of the Indianapolis Traction & Terminal Company, under an agreement whereby it pays 4 cents for each passenger carried on interurban cars while on the city lines.

FIG. I.—CATENARY CONSTRUCTION.

The road is lined with double track in the city of Rushville and on all highways over which it runs. On the private right of way, however, while the grade is prepared for double track, only one line has been laid, as a second track can be more conveniently put down later when a sufficient portion of the road is in operation to require double track. The track is laid with 70-pound "T" rails connected with Weber rail joints, and bonded with No. 4-0 10-in. copper bonds with ⅞-in. terminals under the plates. Cross bonds are put in every half mile and long bonds under all special work.

The poles are all of white cedar, those for the center trolley construction being 40 ft. long with 7-in. tops. The side poles for the high-tension lines are 50 ft. long with 7-in. tops, and all poles are set 6 ft. in the ground. Along streets where it is only necessary to support the span wires on one side, 30-ft. poles are used for this purpose, while on the other side, where the high-tension line runs, the poles are of varying height from 40 to 60 ft., so as to carry the feed wires above the shade trees.

The trolley wire is suspended along the private right of way from poles set in the center of the grade 100 ft. apart, with a bracket made of angle iron looped at the end, so as to carry a large flat porcelain insulator, from the top of which is run a 7/16-in. steel strand cable or "messenger" wire. The No. 3-0 grooved copper trolley wire is carried 8 in. under the messenger cable, to which it is attached every 10 ft. with specially made steel clamps, a construction known as the catenary suspension. The steel messenger wire is drawn tight. With this construction danger from trolley breaks is reduced to a minimum. The insulators are large and strong and are not likely to break, but if they should the steel cable would remain suspended from the top of the bracket. As the trolley is attached to the steel cable every 10 ft., breaks will be very infrequent, and if one should occur not more than 10 ft. of the trolley would be loose. The catenary construction provides a practically level trolley with no sudden bends at the insulators, as is found with the ordinary suspension, a point which is of great advantage to fast-running cars. The trolley wire is suspended 18 ft. above the top of the rail.

Where the tracks are in the streets the poles are set on the sides of the streets and the trolley is suspended from span wires. Otherwise the construction is the same as along the private right of way. The overhead material for the entire line construction was supplied by the Westinghouse Electric & Manufacturing Company, according to the design of Sargent & Lundy, consulting engineers.

The system of electrical distribution requires transformer stations about 10 miles or 12 miles apart, and the alternating current is transmitted from the power house to these transformer stations at 33,000 volts, single-phase, 25 cycles per second, and is reduced and fed into the trolley at a potential of 3,300 volts. The high-tension current is carried from the central power station to the transformer stations on No. 4 bare copper wires, two wires to each transformer station. They make a complete circuit and permit the placing of the circuit-breakers and switches at the central power house, so as to do away with the necessity of attendants at the transformer stations. The high-tension lines are carried on a separate line of poles set near the edge of the right of way, provided with carefully and strongly constructed cross arms and equipped with large porcelain insulators on iron pins.

The entire system is provided with two metallic circuit (four copper wires) telephone lines, one of which is used exclusively by the train despatcher. The other line is used for general company business. Each car is provided with a telephone, by means of which the conductor can talk with the train despatcher at fixed points. Jack boxes are placed on the poles at intervals of 2,000 ft., from any of which the conductor of a car or any one else with a telephone can call up to report an accident or for any other purpose. The four telephone wires are carried by porcelain insulators on cross arms near the top of the trolley poles, and are thus far removed from the high-tension lines. The wires are transposed every 500 ft. in order to avoid disturbances from the current in the transmission lines.

Within the limits of the city of Indianapolis, a distance of approximately three miles, the cars will be run over already existing lines, and will be operated by direct current at 550 volts. Within the limits of the city of Rushville they will be operated by alternating current at the same potential; on intervening sections the trolley will be fed by alternating current at 3,300 volts, 25 cycles

per second, single-phase. Thus the first single-phase railway exemplifies the possibility of operating the same equipment from both direct and alternating-current lines, and illustrates the voltage flexibility of the system, one of its most advantageous features.

The power station from which it is intended to operate the entire

FIG. 2.— TRANSFORMER STATION AT REEDVILLE.

road is located at Rushville. From this plant 33,000-volt transmission circuits are run to the points of transformation and there reduced to 3,300 volts before connection to the trolley.

As has been stated, the road is divided into sections of 10 miles and 12 miles, each of which is supplied with current from a transformer station. Three such stations have been erected between Indianapolis and Rushville by Pulse & Porter, contractors of Greensburg, Ind. The transformer houses are quite small, measuring but 21 ft. x 23 ft., but are carefully and substantially built. The foundations are of concrete; the walls are of brick laid in cement mortar, and the floors for both the first and second stories are of concrete upon steel beams. The roof is built upon concrete base. The doors and windows are provided with steel shutters, and the whole structure is made thoroughly fire-proof and can be closed and left alone with safety.

In each of the transformer stations there are at present installed two 300-kw oil-insulated step-down transformers, 33,000 volts to 3,300 volts. Space has been provided for an additional transformer of the same capacity. On the second floor of each transformer station there are installed the lightning arresters and disconnecting switches. There are no automatic switches of any type in these stations, as they are controlled only through the switchboard in the power station. There is nothing at the station which requires constant attention, and only occasional inspection will be necessary. This does away entirely with the expense usually incident to the rotary sub-station of other systems, which, if three men are employed, would aggregate about $6 per day. The annual saving in wages on the three transformer stations between Indianapolis and Rushville made possible by the alternating-current system on this basis, would amount, therefore, to $6,570, or a total annual saving on the ten transformer stations between Indianapolis and Cincinnati in wages alone of $21,900.

The entire electrical equipment of the transformer stations was furnished by the Westinghouse Electric & Manufacturing Company, and was installed under the supervision of Sargent & Lundy. The disconnecting switches were made from a design specially prepared for this service by these engineers.

The power house serves as an additional transformer station and contains two 300-kw lowering transformers, wound for 3,300 volts primary and 550 volts secondary circuits, which are used to feed that portion of trolley included within the limits of the city of Rushville.

The diagram on page 337 illustrates schematically the general arrangement of apparatus and circuits. The two-phase power circuit indicated is a provision for a four-wire power circuit, which it is proposed to run from the power house in Rushville to the electric line between Indianapolis and Shelbyville, which is at present operated by direct current from its own power house through rotary converter sub-stations and direct-current railway motors. It is expected at an early date to operate this branch also from the central power station in Rushville.

The power house, which is located at Rushville, Ind., is a strictly fire-proof building of brick, concrete and steel, with rooms well lighted and skillfully arranged for future addition and enlargement. The site is adjacent to the Cincinnati, Hamilton & Dayton Railway, with a connecting track from that road to the company's track alongside of the power station. The boiler room occupies one side of the building, and is at present equipped with three 300-hp Babcock & Wilcox boilers. Natural gas is now being used for fuel, but provision is made for the burning of coal, if at any time the supply of gas becomes insufficient. The engine room occupies the other side of the building, and is separated into two parts by a heavy brick partition. In the main room are installed the two generator units, which consist of a 500-kw Westinghouse revolving field alternator, 25 cycles per second, direct-connected to a 700-hp Corliss type, cross-compound, condensing engine, built by the Fulton Iron Works, of St. Louis, Mo. Both engines and generators are designed for

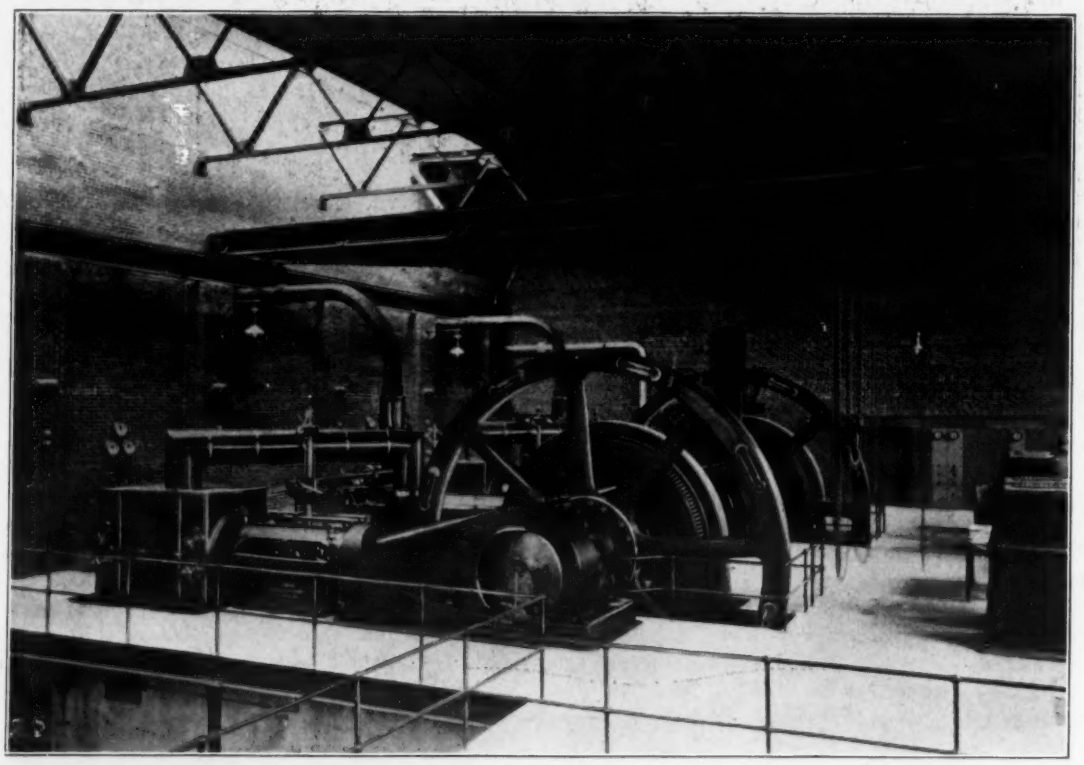


FIG. 3.—INTERIOR OF POWER STATION.

an overload capacity of 50 per cent. Each engine is equipped with an independent jet condenser, made by the Dean Brothers Steam Pump Works, of Indianapolis, which take their water from an underground tunnel connecting to a large mill race. Two pairs of 250-kw air-blast transformers are arranged to change the current

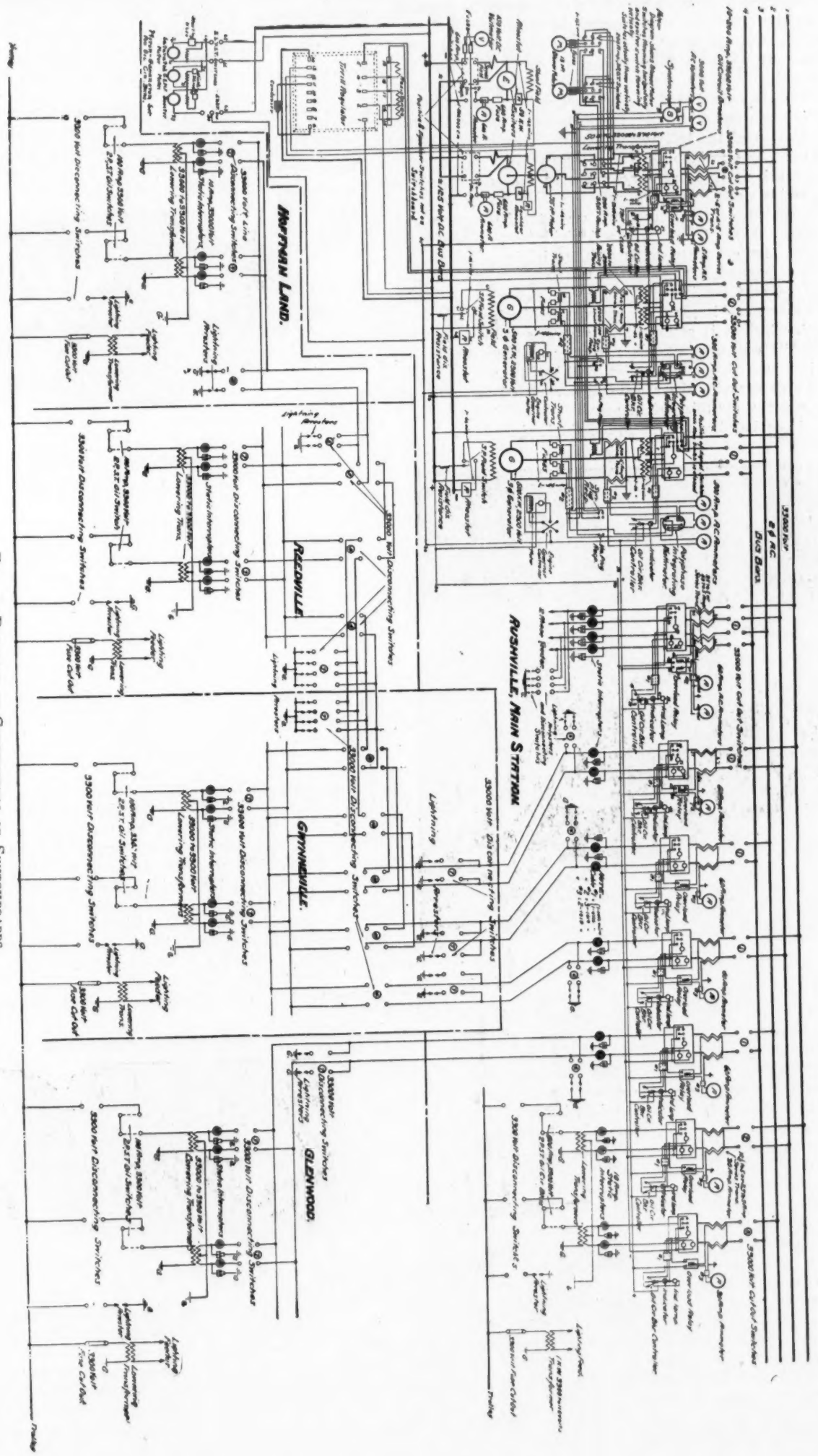


FIG. 4.—DIAGRAM OF CONNECTIONS OF SWITCHBOARDS.

which comes from the generator at 2,300 volts, three-phase, to 33,000 volts, two-phase, for transmission to the transformer station along the line. Air for these transformers is supplied by two motor-driven blowers. The generator field is excited by direct-current generators, one of which is direct-connected to a Westinghouse induction motor; the other to a Westinghouse compound steam engine. The marble switchboard controlling panels are also located in this main engine room, and the controlling apparatus is installed in the other portion of the building, which is known as the high-tension chamber. The main bus-bars are located in the basement and are supported upon a masonry structure and separated by barriers of alberine stone.

The present equipment of the company consists of ten passenger cars, each measuring 55 ft. over all, and divided into three compartments. The first compartment is 9 ft. 10 in. long, and is intended to carry baggage. It is provided with doors opening on either side. The cars are intended for single-end operation, and space for the motorman is provided in front of the baggage compartment, from which it is separated by a strong railing made of pipe. The middle compartment has a seating capacity of sixteen people and is intended for gentlemen desiring to smoke. The third compartment occupies the remaining portion of the car, and has a seating capacity for thirty-eight people.

Each truck is equipped with two 75-hp, single-phase alternating-

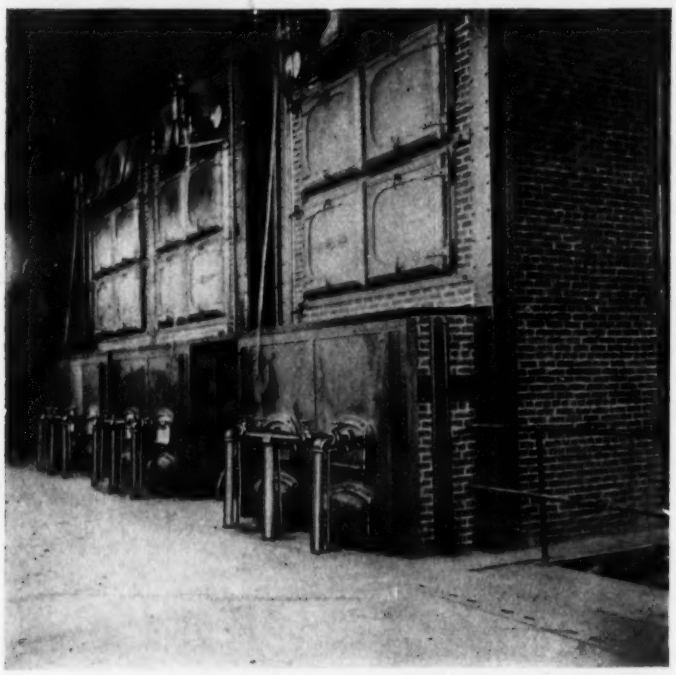


FIG. 5.—OIL BURNERS.

current Westinghouse motors. Cars are equipped with the Westinghouse unit switch system of multiple control, and so may be operated either singly or in trains. The motors are controlled by the rheostatic system, and may be operated on either alternating or direct current. Both straight and automatic air brakes are provided on each car, the straight being used when the cars are run singly, the automatic system when the cars are run in trains. The motors on the present car equipment are geared for a maximum speed of 45 m.p.h. for local service.

Each car is equipped with two trolleys, one of the Union Standard type, with trolley wheel, to be used when operating from the direct-current lines in Indianapolis, or from the low-voltage alternating-current lines in Rushville; the second trolley is of the bow, high-speed type, and has been designed for service at 3,300 volts, alternating current.

Local cars are operated each way every hour, making stops upon signals at all of the cities and towns and at the principal crossings of the country. These cars are all provided with compartments in which baggage and light express matter may be carried. They are designed to run at a schedule speed of 30 m.p.h. To properly take care of the through service, additional "limited" cars will be put on the line; each of these will be equipped with four 150-hp motors, designed to operate at a schedule speed of 50 m.p.h. or 60 m.p.h., as under the provisions of the various franchises they will not have to make any stops in the country or at any of the smaller towns, and will only be required to make one stop at each of the larger intervening cities. It is expected that when the road is completed from Indianapolis to Cincinnati these "limited" cars will be able to make the trip from the center of one city to the center of the other in three hours' time. It is the intention at a later date to run two express cars per day in each direction, taking care of the light freight and express business.

This road has been built in every detail with a view to the handling of heavy freight, even to the extent of carrying it in

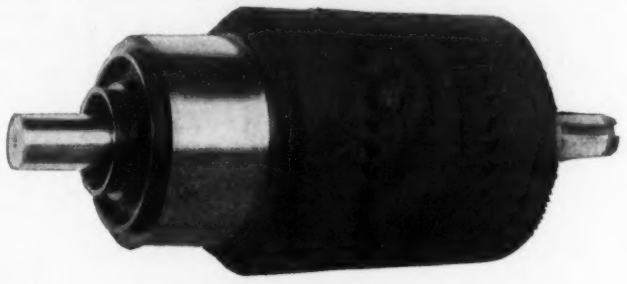


FIG. 6.—ARMATURE.

long trains. Whenever, in the intervening cities, short radius curves could not be otherwise avoided, the private property of the inside corner has been purchased and the sidewalks and curbs set back so as to make easy curves and permit the handling of heavy trains.

An average fare of 1½ cents per mile is charged by the company for carrying passengers, the road being divided into five-cent sections; no fare less than five cents is charged for any ride. A school children's ticket is issued, good for use one hour before or after school hours. A mileage or sectional ticket is also issued at a reduced rate, giving 160 five-cent rides for $7, a reduction of 12 per cent. from the ordinary fare. No other tickets are sold and cash fares are collected on the car.

The car shops are located near the power station. The entire building is 205 ft. by 104 ft. and is divided as follows: Offices and waiting room for train crews, storeroom, blacksmith shop, car wash room, machine shop, truck repair shop, room for winding and drying armature and field coils and for other electrical work, paint shop and carpenter shop. Six tracks enter the building, each of which is provided with a working pit. A transfer track runs across the center of the building. The construction of the building is fire-proof throughout, with concrete foundations and floors, brick walls and steel framing. The roofs are made of asphalt gravel laid upon a cinder and concrete base, with louvers and skylights, all in steel frames. Concrete partitions are used where brick walls have not been constructed, and there is a Kinnear iron door over every track. The machine shop is occupied with a full equipment of modern tools. Provision is made in the center for a traveling crane to run the entire length of the building.

John W. Moore, chief engineer of the Indianapolis & Cincinnati

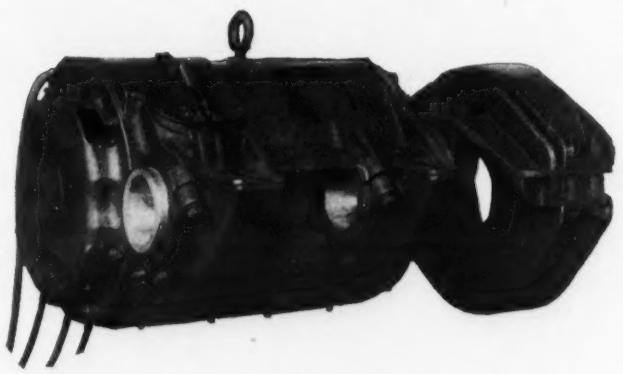


FIG. 7.—SINGLE-PHASE MOTOR.

Traction Company, has been particularly active in the construction of the roadway, bridges and track work. Arthur A. Anderson, general superintendent of the company, has carefully supervised the entire work of construction and operation. His past experience with the Indianapolis Street Railway and the Mahoning Valley Railway Company, of Youngstown, Ohio, has fitted him in a peculiar way for his present duties.

A British Switchgear for Sub-Station Control.

The sub-station erected on Fisher Street, London, by the Metropolitan Electric Supply Company to take up the load formerly carried by the historic Sardinia Street station, is unique in the amount and variety of switch gear required. The high-tension voltage used by this company is, in a sense, the highest to be found in the United Kingdom—10,000 volts on each of the two phases, with one end of each phase earthed—giving over 14,000 volts between the unearthed conductors.

On the other hand, the direct-current voltage is unusually low, the system of distribution being three-wire, with 100-volt lamps, calling for a voltage across the outers at the sub-station, varying from 220 to 250 volts. The complete equipment of this sub-station, including the batteries, will easily be able to take care of a peak load of 25,000 amp. at this voltage. Thus, the input is at an unusually high voltage; the output is an unusually large current, while the number of machines and feeders is also unusual, the station being laid out for an eventual capacity of ten 500-kw motor-generator sets, three three-wire storage batteries, three balancers, six battery boosters, two starting machines, four extra high-tension lines and 105 direct-current feeders.

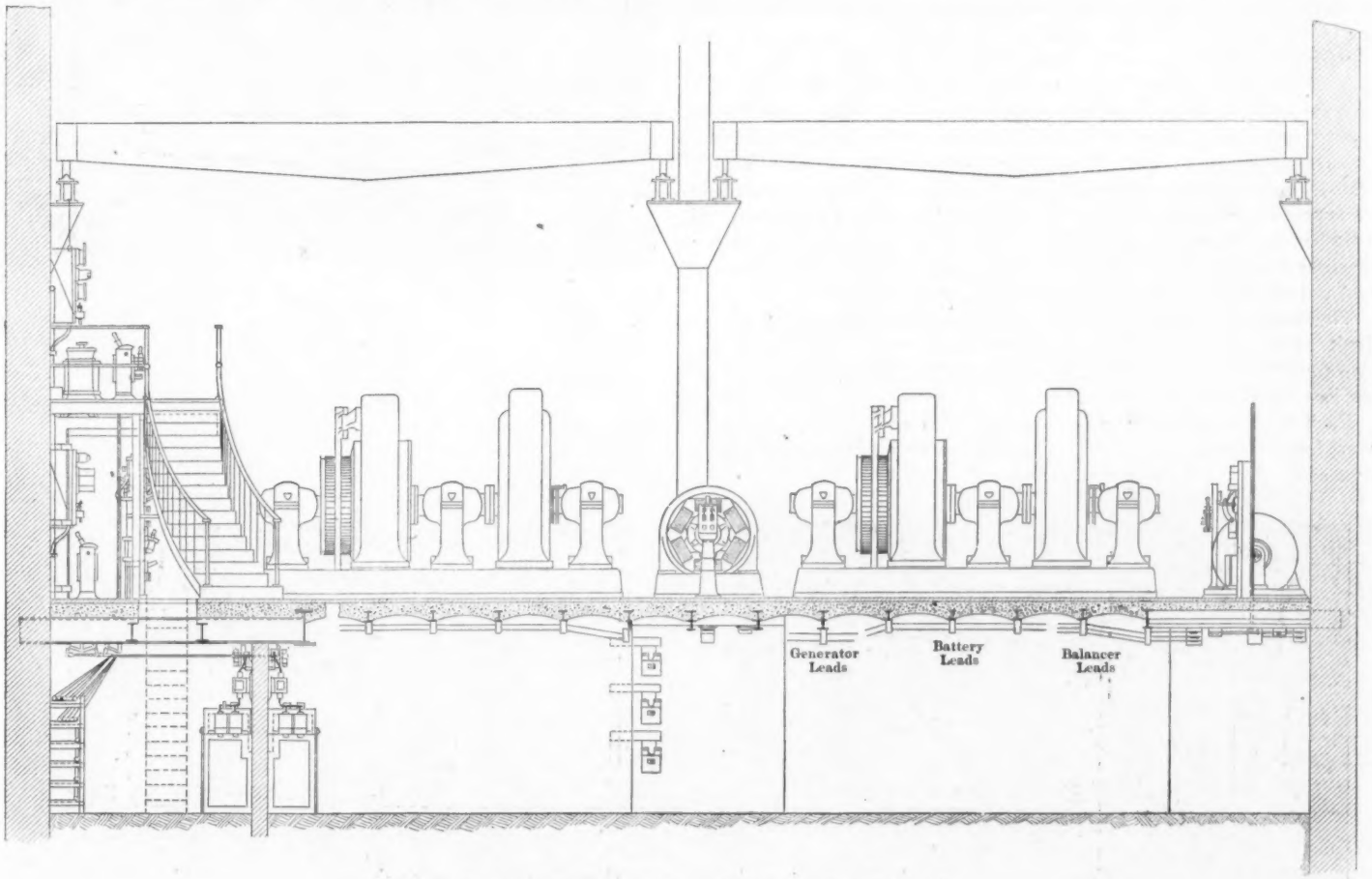


FIG. 1.—SECTION THROUGH FISHER STREET SUB-STATION.

To control this equipment, there has been installed a main low-tension board, running the whole length of the station—75 ft.—a gallery above the same (Fig. 2) filled with instrument panels, rheostats, control handles, etc., and a subway the same length filled with extra high-tension gear; in addition to various incoming line equipments, booster panels, balancer starting gear, a station lighting panel, etc., scattered at various points convenient to the corresponding machines or circuits.

The most striking feature of this switch gear as a whole is the arrangement by which both machines constituting a motor-generator set are handled entirely by remote-control equipment from one position.

Both the extra high-tension switches feeding the synchronous motors and the corresponding direct-current generator panels are mounted approximately opposite their respective machines; the extra high-tension gear being in the basement, and the direct-current panel on the floor immediately above. In the gallery immediately above both the extra high and the direct-current equipments, there is mounted a pedestal with operating handles for all of the switches normally used in handling the set, both alternating and direct current, both types of switches being mechanically controlled from this distance by means of gas pipe and bell-crank connections, in the same way that extra high-tension oil switches have been controlled in the past, this arrangement being unique in its extension to direct-current apparatus.

Against the wall in the gallery immediately behind the above-mentioned pedestal, is a panel carrying all the instruments, and all small switches, such as field switches, synchronizing receptacles, relays, etc., but without any extra high-voltage or heavy-current leads whatever upon it, all instruments being fed from current transformers, potential transformers, shunts, etc., suitably placed on the panel or in the cells down below, all of the small leads being brought up to the instrument panel through steel piping. This arrangement gives the attendant complete control of one unit from one point. Under his hand he has the direct-current starting switch, the positive and negative main circuit-breaking switches, the extra high-tension oil switches, the generator and motor field rheostat hand wheels and the corresponding field discharge switches. In front of him are the direct-current voltmeter and ammeter of the corresponding generator, together with an alternating-current voltmeter and alternating-current ammeters for the two phases of the synchronous motor. On the same panel are two field ammeters, one for the generator and the other for the motor, as well as the synchronizing receptacle, alternating-current relays, switch indicating lamps, etc.

Taking up the switch gear more in detail, the extra high-tension power is received in the two-phase form, 60 cycles, 10,000 volts, as generated in the power house of the company at Willesden. It enters the Fisher Street sub-station via four transmission lines, two from one other sub-station, and the other two from a third sub-station, which in turn is independently supplied, thus linking these various sub-stations in a ring system, with lines duplicated each way around the ring.

Each such line consists of two concentric cables. The outers of these cables are earthed at Willesden, and are all of practically earth potential throughout. They are, therefore, easily controlled

by open-air knife switches of ordinary low-tension types. The inners are, however, controlled by high-voltage oil-break switches of the British Thomson-Houston single-pole type, one in each phase. These switches are arranged for automatic tripping by means of overload relays operated by current transformers, connected in the outers. Each phase of the incoming lines, i. e., each cable, can be tripped independently of the other. (See Fig. 3.)

The extra high-tension gear for the synchronous motors is similar in character, in that it consists of two single-phase oil-break switches in separate masonry cells with knife switches in the outers (Fig. 4). these knife switches being mechanically interlocked with the oil switches, so that the knife switches cannot be opened when the oil switches are closed, or the oil switches closed when the knife switches are open. This method of operation is advisable, as otherwise the 10,000-volt circuit could be opened on the outer switches, or a machine could be closed on the inner switches, with the outer switches open, which would give 20,000 volts on the outer as soon as the synchronous motor drifted out of phase. In the case of the machines the current transformers which operate the overload relays are connected in the inners between the machine oil switch and the synchronous motor, the idea being that a breakdown of the insulation of the high-tension motor winding to the frame would cause a heavy rush of current from the power station into the synchronous motor, and thence back to the power station through earth, which current would not pass through the outer cables or any current transformers connected therein. By the scheme adopted a certain amount of selective operation is obtained between the machine oil switches and high-tension feeder oil switches, the breakdown of any machine tending to operate the corresponding machine switches only, and not to trip out the lines between the stations.

The automatic devices for the machines are so arranged that a fault or overload on either phase opens both oil switches on the two phases, differing in this respect from the independent automatic devices for the incoming line.

Each synchronous motor is equipped with one pilot or potential transformer for synchronizing, and for properly adjusting the voltage when the machine is run up from the direct-current side. Each parts. The oil switches are in stone chambers or cells, with steel plate doors, which are normally locked, but even if these doors are opened access can only be had to the oil switch tanks, mechanism,

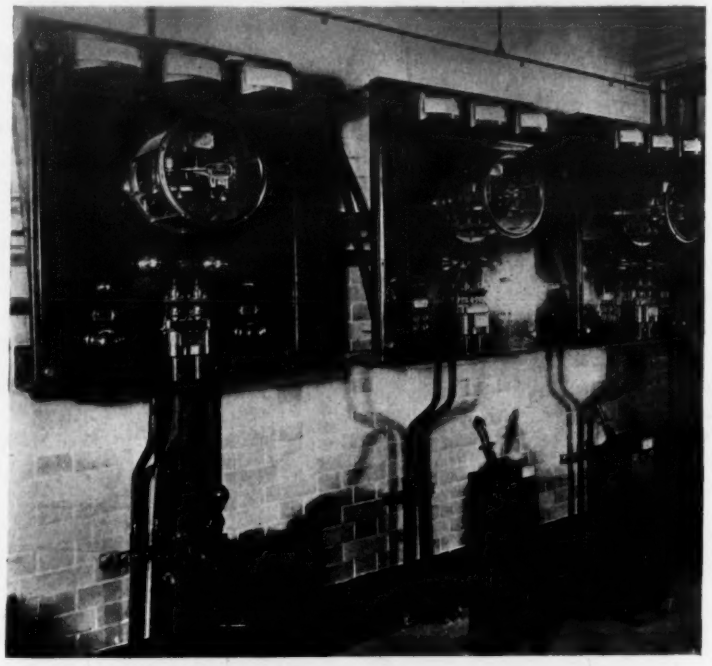


FIG. 3.—THREE OF THE FOUR PANELS AND OPERATING PEDESTALS FOR HIGH-TENSION LINES.

etc., all of which are earthed. Access to the live parts of the switch can be obtained only by removing the switch tank.

The high-tension sub-station bus-bars are made up of concentric cables, the inner core of which is the only dangerous conductor, the

FIG. 2.—GENERAL VIEW OF SWITCHBOARD GALLERY.

of the four transmission lines is equipped with two potential transformers for the voltmeters on each phase, power factor indicators and recording watt-hour meters, designed to measure the total station input.

The high-tension connections throughout the station are unique for their complete enclosure of all high-tension, current-carrying outer core being of practically earth potential, and being insulated and surrounded by the usual lead sheath, which in turn is solidly earthed. For branch lines this concentric lead cable bus is tapped into the oil switches in large cast-metal, cable-dividing T boxes mounted on top of the oil switch cells, the inner being carried down directly through the bases of these boxes into the oil switch cells

through long corrugated porcelain insulators. The boxes are filled with extra high-tension cable compound. No knife disconnecting switches or links of any kind are provided for isolating the oil switches from the sub-station bus-bars, but the extra high-tension bus is divided by three sets of oil (inner) and knife (outer) switches into four sections ,any one of which can be shut down, when the other three sections are carrying the load, thus allowing cleaning or the making of alterations to any part of the gear, without exposure of the extra high-tension inner conductors.

The only points at which the high-tension inner conductors are at all exposed are the terminals of the glass tube fuses used to pro-

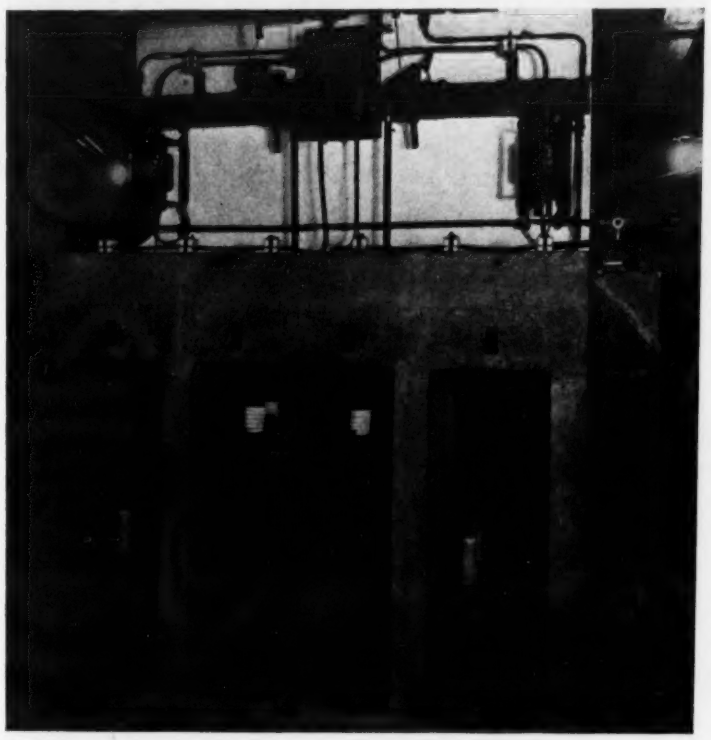


FIG. 4.—10,000-VOLT OIL SWITCHES IN MASONRY CELLS, PILOT TRANSFORMERS AND AUTOMATIC RELEASE GEAR.

tect the potential transformers. These fuses are mounted on their transformers in masonry cells with doors normally locked.

This enclosure of all extra high-tension parts in cable boxes or switch tanks, is somewhat novel, as compared with ordinary three-phase work with non-insulated bus-bars in compartments, and so extreme as to be at times awkward when it is desired, for example, to apply a short-circuit for testing or for drying machines, but it has proved most remarkably safe in combined operation and construction; a large amount of work having been done by men in actual contact with the extra high-tension bus-bars, considering the cables as such, after the station was in continuous service.

The main direct-current, low-tension switchboard on the machine room floor is made up of black enameled slate panels solidly bolted to 3-in. by 5-in. "H" girders, these girders being framed into the building, and form supports for the gallery, the latter having been designed to suit the switch gear. The lower half of this board is devoted to the negative side of the system, and the upper half exclusively to the positive side of the system, the two polarities being isolated by means of a slate shelf extending in front of and behind the main panels, throughout the length of the board. Each polarity is fitted with duplicate bus-bars, which will be used for running at two voltages. As seen in Fig. 5, each of these four bus-bars is divided into three sections by means of eight switches. The feeder panels are distributed between the generator panels, so that there is no great concentration of current in any one section of the bus-bars, each of which is of 6 sq. in. cross-section.

Each generator panel is equipped with one Thomson recording wattmeter, one 3,000-amp. ammeter shunt, and in each polarity one double-throw B. T.-H. 3,000-amp. laminated brush switch, by means of which the machine can be transferred from one set of bus-bars to the other, this being normally done when the machine is out of service. Each polarity is also equipped with one B. T.-H. 3,000-amp. remote-operated switch of a circuit-breaking type, handled from the gallery above. The switch of this type on the positive polarity is equipped with a reversal relay which is set for about 600 amp., i. e., just sufficient to act as an overload relay when the machine is being started from the direct-current side.

The 105 direct-current feeders, for which provision has been made at this station, consist of concentric or triple concentric lead-covered cables, varying from 1 sq. in. concentric to .4 sq. in. triple concentric. To allow ample room for safely drawing the lead-covered cable up behind the live board and for fixing the fittings for carrying the currents into their conductors, the main bus-bars have been placed on the front of the board. Each feeder is protected by switch fuses, which are made double-throw, so that the feeder can be connected to either the high or the low bus.

On each polarity of each feeder there is also an ammeter shunt, two ammeters, one positive and one negative, being provided for each five feeders, with suitable swivel switches so that each ammeter can be connected to any one of five shunts. The outer conductors of the triple concentric feeders are connected through suitable clamp fittings and screw plugs to a neutral bus, which runs along the base of the board near the floor.

In the main switchboard there are also three battery panels, each equipped with double-throw laminated brush switches, by means of which the battery can be connected to either the high or the low bus on each polarity. The main control of the battery is, however, accomplished at the booster panels, which are located near the boosters. The neutral bus is connected to the center of the battery, enabling the battery to assist in balancing the system, especially in the case of out-of-balance faults. There are no end cell switches, all variations of battery voltage being obtained from boosters, which are driven by the balances.

Each balancer drives two boosters, one for the positive and one for the negative end of the corresponding battery. Adjacent to each booster is a corresponding booster panel, equipped with three main switches by means of which the battery can be connected either through the boosters to the bus-bars or directly to the bus-bars with the booster kept entirely clear. A small center-zero voltmeter at

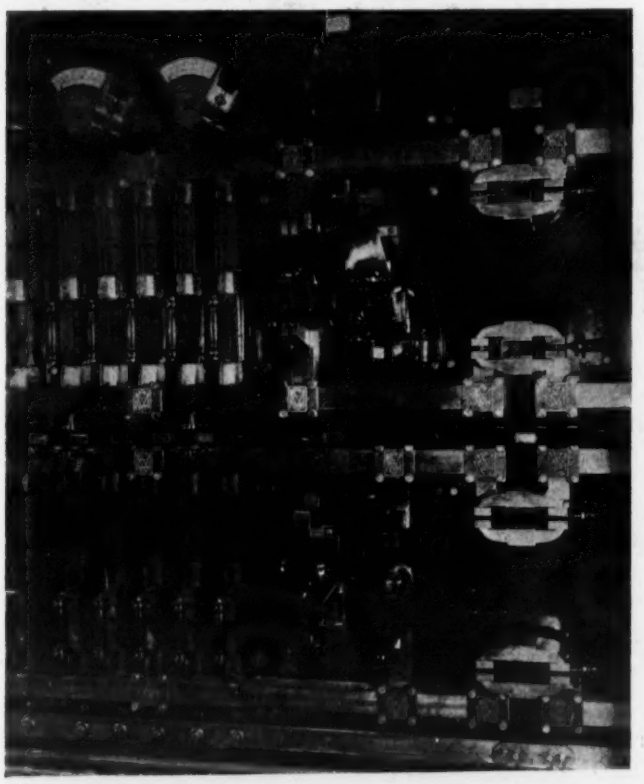


FIG. 5.—VIEW OF MAIN DIRECT-CURRENT SWITCHBOARD, SHOWING 5000-AMP. SECTIONALIZING SWITCHES.

the top of the panel indicates the amount and direction of the voltage of the booster.

Each battery equipment is designed for a load of 4,000 amp., i. e., 4 sq. in. of copper have been put in each lead, and each meter, etc., has been designed for the same current. Each battery is supplied with two Thomson recording wattmeters with ratchets, which prevent them from running backwards, the connections of one meter

being reversed so that one indicates the total charge while the other indicates the total discharge of the battery. (See Fig. 6.) Each battery is also equipped with one curve-drawing main ammeter, one curve-drawing neutral or out-of-balance ammeter, and one curve-drawing voltmeter connected directly across the cells.

The balancers are connected with fields crossed and with one field rheostat consisting of a fixed resistance between the fields, with a movable tap from the neutral bus-bar. Each booster is equipped with a series shunt reversing rheostat with contacts so arranged as to connect the booster field across any desired voltage from 125 volts positive to 125 volts negative.

Provision has been made in the switch gear for automatically cutting off the torque of the booster by opening its field circuit in case it should tend to run away on the battery current when the balancers are disconnected from the bus-bars due to blowing of their fuses or any other cause. This provision has been made, as it is considered inadvisable to put any automatic circuit-breaking switches in the battery circuits, the idea being to keep the batteries connected to the bars through all emergencies, unless they be disconnected by hand. To provide for such manual disconnection, the booster panels are equipped with brush-toggle switches, with magnetic blow-out auxiliaries, which are capable of clearing the maximum output of a battery on a short-circuit.

Various provisions have been made for starting the motor-generators. As a rule, they are started from the direct-current bars through a starting box (Fig. 7) with an induction motor-generator set as a reserve in case the direct-current power fails completely. This induction motor-generator set may be connected on the direct-current side to any generator, entirely independently of the main bus-bars.

In addition to the usual starting equipment is a motor-driven booster, or to use a somewhat more explicit term, which has been applied to this machine, a "depressor." This machine consists of a

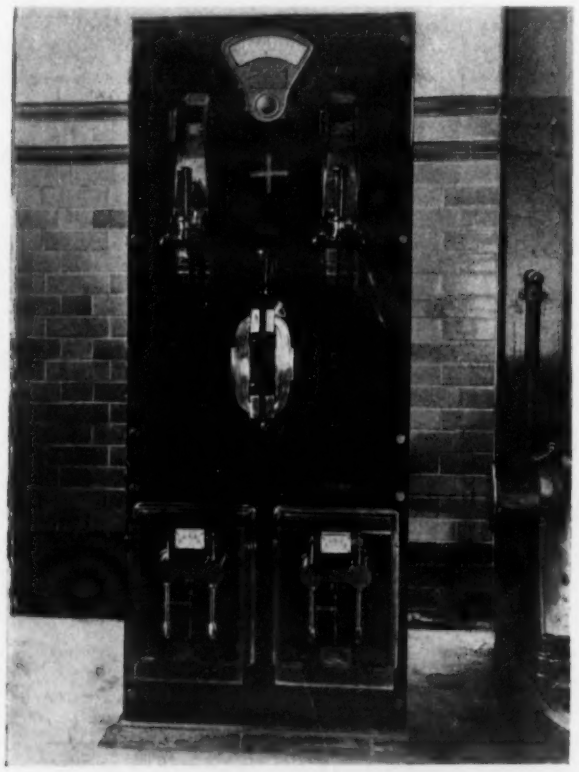


FIG. 6.—4000-AMP. BOOSTER PANEL, SHOWING CHARGE AND DISCHARGE WATT-HOUR METERS.

direct-current motor driving a direct-current generator, which can be connected in place of the starting box. In practice the depressor is thrown into circuit with a voltage approximately equal to that across the bus-bars, after which the depressor voltage is gradually lowered, thus bringing up the voltage on the unit to be started. The advantage claimed for this machine is that a unit can be started from rest with about 100 amp. instead of the 400 or 500 amp. usually required when starting through a dead resistance. The starting current runs up as the depressor voltage is lowered, since the depressor returns less of the starting power through its motor as the voltage of its depressing end goes down. As the starting current is much more than the accelerating current, the depressor cuts down considerably the maximum demand for power at starting.

All of the starting gear has been so designed that current for starting can be taken from any section of the bus, either high or low, but no one bus or section of a bus can be paralleled with any other by any accidental manipulation of the starting switches. Similarly no one machine at standstill can be thrown in parallel with another

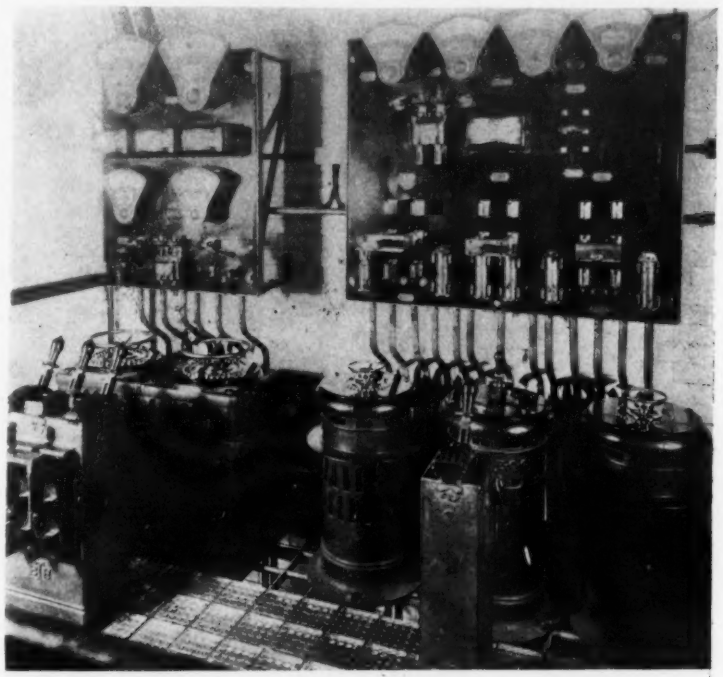


FIG. 7.—MOTOR-GENERATOR EQUIPMENT OF INSTRUMENTS, SHOWING STARTING GEAR.

up to voltage through mistakes in the manipulation of the starting switches.

In addition to the above-described instrument panels on the operating gallery, there are others for the batteries, also one bus-bar voltmeter panel and one pilot panel, equipped with six voltmeters and suitable voltmeter switches and pilot wires for measuring the voltage at the centers of distribution of the network.

The switch gear described above was designed according to the specifications of Mr. J. S. Highfield, chief engineer of the Metropolitan Electric Supply Company, Limited, who was the originator of several of the unique features which it embodies, such as the remote control from one platform, the protected extra high-tension connections, the depressor method of starting, etc. The gear was designed in detail, constructed and installed by the British Thomson-Houston Company, Limited, electrical engineers and manufacturers, Rugby.

Cross-Connection of Series Motors.

By D. Kos.

IN a recent issue of the German engineering weekly, *Der Ingenieur,* is to be found a lengthy mathematical article by A. Ham describing some interesting connections of series motors. From the information there contained the following brief description has been prepared.

In addition to the usual plain series and parallel arrangements there are other possible connections of series motors. The arrangement shown in Fig. 1 may be designated as cross connection. For the purpose of analysis of performance, assume that the two armature currents, I_1 and I_2, are equal. The torques of the two motors will be equal also, and the machines will operate like two common parallel-connected series motors. When, however, one of the currents, for example, I_1, increases, the field magnetism of motor II will increase, giving a greater counter e.m.f. to the armature. Consequently, the armature current of motor II and field current of motor I decreases. I_1, therefore, increases, and the final result is that no current passes through the armature of motor II and none

through the field core of motor I, so that neither machine exerts a torque.

When the two motors are mechanically coupled, motor II will become a dynamo when I_1 increases. A current, I_2' (in opposite direction to I_2) will flow through the armature of motor II and field coil of motor I, which latter machine will become a dynamo also. The two machines will act as brakes taking current from the supply system. The change from motor to brake is quite rapid. The condition here assumed continues until the power-consuming machine is so retarded in speed that in spite of the excessive strength of its field magnets the voltage of motor II is equal to that of the supply system. No current then flows through the armature of motor II or the field coil of motor I, and neither motor possesses torque. Each machine will now receive current from the line and operate as a motor until the speed has increased and the above-described cycle is repeated. Two motors in cross-connection, therefore, possess a tendency periodically to accelerate and retard, and such connection is consequently impracticable for service.

An improved arrangement of circuits which can be used with much success in special cases is shown in Fig. 2, and may be designated as half cross connection. In this arrangement each motor is provided with two series field coils. The current which traverses each armature must pass through one field coil of each motor. When one of the motors has no load, its speed will not become excessive,

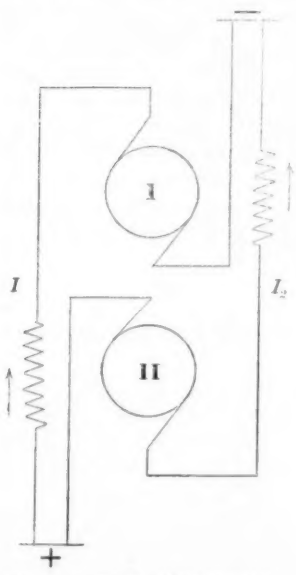


FIG. 1.—CROSS-CONNECTION.

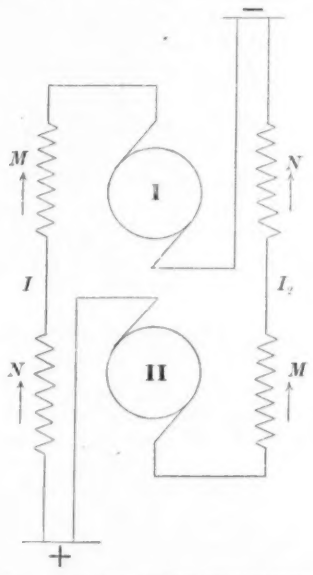


FIG. 2.—HALF CROSS-CONNECTION.

for the armature current of the other motor will increase and will strengthen the field of the first machine and thus prevent the speed from increasing appreciably. If the load be removed from both motors simultaneously, however, they will possess a tendency to reach a dangerous speed. When the fuse of one motor melts that of the other will melt also, for the counter e.m.f. decreases very much, and consequently the current increases.

It can be shown that two motors interconnected electrically as indicated above possesses an inherent tendency to run at the same speed even though they be not mechanically coupled. Consider two similar motors in half cross connection, running at the same speed, and producing the same torque. Assume that the load on one motor is increased, that on the other remaining constant. The former motor decreases its speed and therewith its counter e.m.f.; more current passes to its armature, increasing the strength of its own field and that of the other machine so that the latter motor having its counter e.m.f. increased must slow down in order that its armature receive the proper current to give the requisite torque. A little consideration will show that under any condition of operation the field strengths of the two machines must be equal—quite independent of the points along their magnetization curves at which they may be operated, though modified by the effect upon the individual fields of the separate armature currents. Except for the variation of resistance drops in the two motor circuits the counter e.m.f's of the two machines must be substantially equal, so that independent of the load on each machine the speed of the one must be closely the same as that of the other.

The principal advantages of the half cross connection are found in the fact that if the load on one of the motors suddenly disappears (breaking of shaft, or slipping of wheels in traction work) there will be no danger of too high speed being attained, and that mechanically independent motors will run at almost equal speeds even when the load on the two may be variable in different ways.

A New Design for Slow Speed Induction Motors.

By Prof. Clarence P. Feldmann.

SOME trouble has been experienced in designing induction motors of medium size for draining pumps in mines. These pumps require a low speed, say 220 r.p.m. or less, at an output of 50, 100 or more hp, the frequency being between 40 and 60 cycles

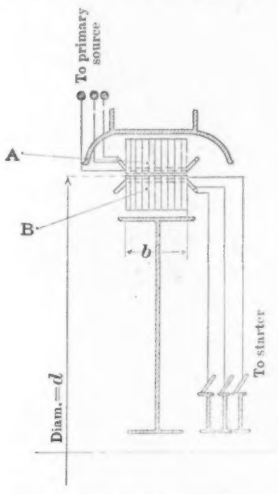


FIG. 1.—NORMAL DESIGN OF INDUCTION MOTOR.

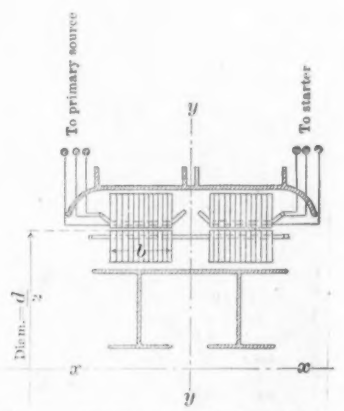


FIG. 2.—SPECIAL CONSTRUCTION DOUBLE MOTOR.

per second. Now for 50 cycles and about 3 to 5 per cent. slip, such a 50-hp motor would require 28 poles; and even if the pole pitch, t, were cut down as far as practical reasons permit, the diameter of the motor would be large, and the axial width very small. But decreasing the pole pitch and a given air-gap, a, means an increase of the leakage factor, δ, which, according to Behrend, is approximately expressed by the equation,

$$\delta = c\,\frac{a}{t},$$

c being a factor dependent upon the shape and size of the slots and the stray fields in the end connections, which will be relatively larger

FIG. 3.—ROTOR OF DOUBLE MOTOR. SECONDARY OF NO. 1, PRIMARY OF NO. 2.

in a motor of excessively small axial width than in one of about normal proportions.

We could, of course, increase the pole pitch, but this would mean

an increase of diameter, of weight and price of the motor, at the same time increasing the cost and difficulty of erecting it in the engine pit. Sometimes it has been found necessary to divide the motor in one or two planes vertical to the plane of revolution, in order to be able to transport the parts down into the sump-shaft.

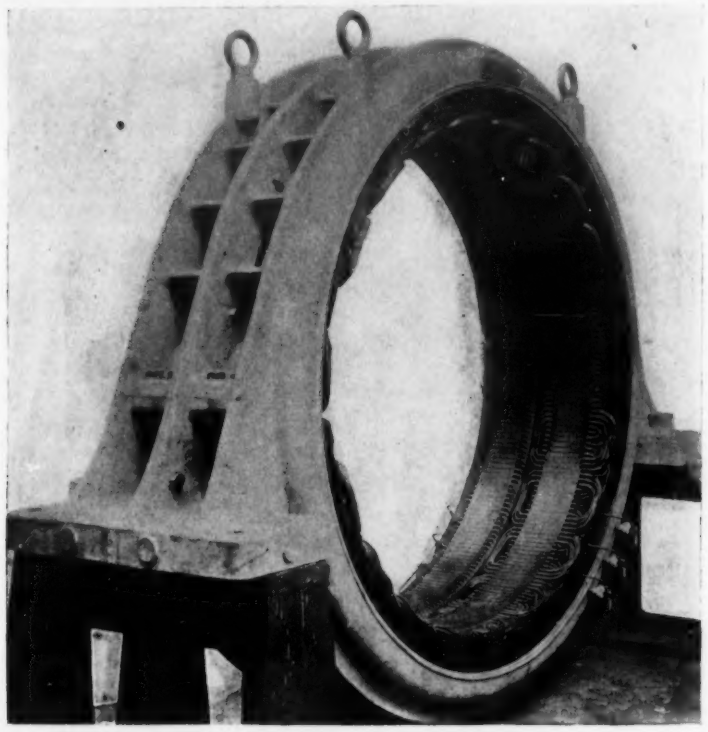


FIG. 4.—STATOR OF DOUBLE MOTOR. PRIMARY OF NO. 1, SECONDARY OF NO. 2.

This involves complicated means for centering the rotor so as to have the same air-gap all around, and requires some space in the pit so as to be able to insert the last few stator windings after erection of the mechanical parts of the motor. Another consideration for the designer was the fact that without some starting resistance for the secondary the magnetizing current became too high and the power factor too low, while with a starting device, sliding rings and brushes were inevitable, no matter whether the rotor was made the primary or secondary part, and sparks likely to be produced under these brushes might cause explosions of mine gases.

All these troubles appear to have been overcome by the construction of a double motor due to the Berliner Machinenbau Actien Gesellschaft vormals L. Schwartzkopff, of Berlin. This solution avoids all the difficulties mentioned by splitting the motor of diameter *d* and width *b* (Fig. 1) into two halves, each of diameter *d/2* and width *b* (Fig. 2), which are wound in about the usual way, and connected in series. The motor thus consists of two stators placed in

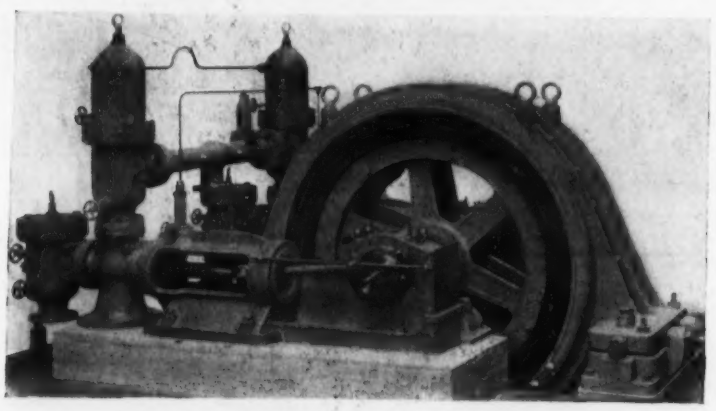


FIG. 5.—DOUBLE INDUCTION MOTOR, DRIVING PUMP.

the same casing and two rotors connected to the same shaft. As the number of revolutions of this motor (Fig. 2) ought to be the same as those of the motor in Fig. 1, each stator and rotor is wound for only half the number of poles. Moreover, it is possible to make the left-hand stator the primary part for the first; the other rotor the primary part for the second motor, so that the second stator would only be magnetized with the frequency of the slip, thus showing negligible iron losses and permitting the connection of the starter to three fixed points.

The two rotors are connected in series; they have to correspond to each other and may be wound in the simplest possible way, i. e., as a squirrel cage or with a bar winding connecting the two rotors. Fig. 3 shows the actual bar winding used. Fig. 4 illustrates the casing, which is amply provided with cooling ribs and contains the two stators, the right-hand one with three slots per pole and per phase serving as primary, and the left-hand one as secondary, winding of the double motor. Both figures show that two divisions along the axis *x x* and *y y* (Fig. 2) are possible, and that the motor is simple in winding and of good general appearance. These divisions are frequently of high value for erecting draining pumps in the shafts and sumps of coal and ore mines. For direct connection to the pump, as shown in Fig. 5, a horizontal division is essential.

Pumps, as a rule, do not require heavy fly-wheels, and as the casing and the constructive parts, spokes, etc., of the double motor are lighter than those of the simple type, the total weight will be decreased. The gap, *a*, may be decreased also, on account of mechanical reasons, to a very small value, and as the pole pitch, *t*, is the same as before, the diameter and number of poles being halved, the leakage factor will be smaller and the power factor better. The total volume of active sheet iron is the same in both solutions (Figs. 1 and 2); but now only one-half of the iron is magnetized with the full frequency of the primary current, and therefore hysteresis and eddy current losses will be less than before. And as the copper losses are practically unaltered and the loss by the friction and contact resistance of the brushes is avoided, the total efficiency of the double motor will be rather higher than that of the simple motor.

The new solution seems thus especially adapted for the purpose in question; that is, for an output of about 200-400 hp at speeds ranging from 120 down to 80 r.p.m.

Some Data of the A. E. G. Steam Turbine.

BY FRANZ KOESTER.

IN November, 1904, the German Electrotechnical Association celebrated in Berlin its twenty-fifth anniversary. With this celebration was connected a small but extremely interesting exhibition of the most recent inventions, to which many manufacturers

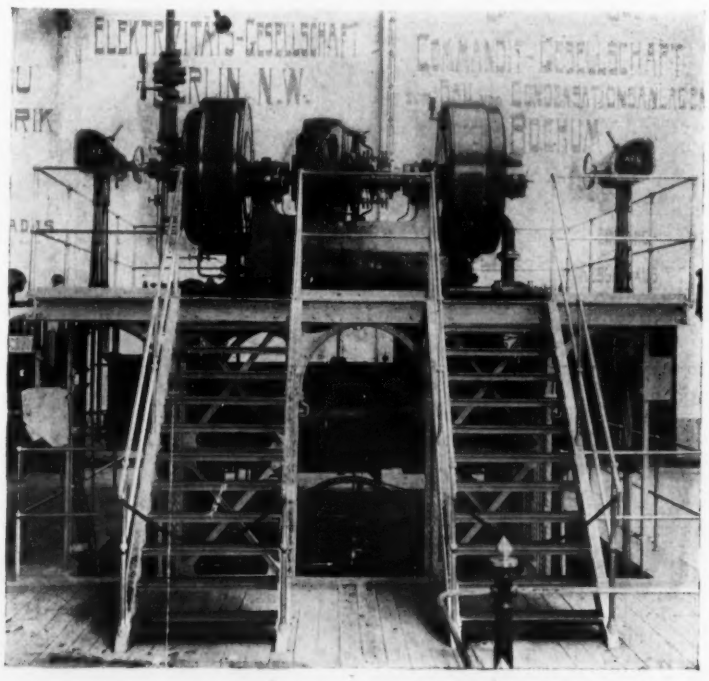


FIG. 1.—STEAM TURBINE PLANT, BERLIN EXHIBITION, NOVEMBER, 1904.

contributed their latest productions. One of the most interesting features was a single unit steam turbine plant, which is shown in Fig. 1. This type of turbine is manufactured by the Allgemeine Elektricitäts-Gesellschaft, of Berlin, its design being based on the

Riedler-Stumpf turbine patents, and quite a number of the machines have been installed during the past several years in European power plants.

The distinguishing features of the A. E. G. turbine are overhanging running parts, with only two bearings, and generator built in the center. All these turbines, whether single or double-stage, have one common bedplate. In the smaller units the bearings are cast solid with bedplate. Large sizes have their bearings bolted on. Double-stage turbines are built with the two runners over-

FIG. 2.—STEAM TURBINE RUNNER.

hanging at each end, with the electric generator in the center between the two bearings. The steam casings are bolted on the outer ends of the bedplate in such a way as to provide for the greatest expansion.

Four-stage turbines have the same general appearance as the two-stage type, and have two runners in each casing. As seen in Fig. 2, the turbine runner is a disc with the buckets milled out of the solid. Since nickel steel is used it is capable of standing enormous velocities without danger of failing, or of changing its shape. As about 50 per cent. of the circumference of the runner is cut away (in milling the buckets) any defects in the steel would become apparent during construction.

Steam may be admitted at the top, the bottom or either side of the casing, according to the requirements. In any case it passes through fine wire gauze to a steam chest at the center, from which it is carried through a series of nozzles to the circumference of the runner, where it impinges on the buckets. In the case of the single stage the steam passes on to the exhaust chamber, or in multiple-stage turbines passes on to the next runner. Speed regulation is attained by means of a governor (directly operated from the main shaft), which admits steam through a greater or less number of steam nozzles, thus securing about the same degree of economy whether running at full or partial load. Although the governor is of simple and certain action, there is used with it a safety device, so that if the speed exceeds 15 per cent. above normal, it operates a quick-closing valve and stops the turbine. The governor is also connected to the throttle in such a way that it acts as an emergency quick-closing valve. Tests made on different sized turbines show that the governor controls the speed with such perfection that there is a variation of only 5 per cent. from normal speed between full load and no load, and only 2 per cent. variation for a load change of 25 per cent.

The main shaft has collar bearings. Oil is supplied to the bearings under pressure from a pump operated directly from the main shaft, using it over and over. It flows through a cooling chamber in smaller turbines, while in the medium and larger sizes the bearings are kept cool by means of a water jacket.

On account of the speed of these turbines (from 3,000 revolutions for 100 kw to 750 for 5,000 kw) it is of the highest importance to build the rotating parts of the electric generator very rigid and durable, and to have it in perfect running balance. The machines are tested in the shop at a speed 50 per cent. above the normal, to be certain that all features, particularly the winding, should stand all reasonable speeds without in any way disturbing the running balance.

In order to assure themselves of the highest efficiency of their turbine plants, the Allgemeine Elektricitäts-Gesellschaft build their own condenser outfits. These are generally surface condensers, because the condensed steam, being entirely free from oil, may be used for boiler feed water. Where the cooling water is sufficiently pure for boiler feeding, the jet condenser may also be used, as the turbine is adapted for use with any kind of condenser that would serve a reciprocating engine; and it may also be operated non-condensing.

The highest economy in the steam turbine is subserved by the best possible vacuum and as great a superheat as can be supplied, for there is no limit to the degree of superheat that this turbine will stand. In respect both to vacuum and to superheat, the turbine is superior to the reciprocating engine. In the latter the leakage of piston and exhaust valves, the wire-drawing of exhaust steam, etc., tend to vitiate the vacuum, while the unequal expansion of parts, the difficulty of steam lubrication and trouble with packings may seriously interfere with the highest degree of superheating.

Continental practice has shown that the most efficient arrangement is to have the condenser directly underneath the turbine, and if possible bolted direct to the exhaust nozzle; and if not, with as short a connection as possible, through a water-sealed stuffing box. The efficiency is also increased by having the pump for handling water of condensation below the condenser, and as nearly direct connected to it as possible. With this arrangement it is practicable to obtain a vacuum of 97 per cent. of barometric reading. This also makes a compact unit, as the turbine itself does not occupy any more space than the condenser plant arranged as above.

Inasmuch as the turbine requires but little attention, and may run continuously for months, it is entirely practicable to set it up on a platform above the main floor (especially as it is not very heavy), and install the condenser outfit on the floor, or in a shallow pit.

FIG. 3.—TURBINE GENERATORS IN ERECTING SHOP.

This places for convenient attention the parts of the plant which need it most. Such an arrangement as this is illustrated in Fig. 1, from which it may be seen that all parts of the plant are very easily accessible. Most continental engineers use motor-driven condensers of one sort or another for all purposes, in connection with electric installations.

Tests of the A. E. G. turbine show steam consumption in a 200-hp turbine 12¾ pounds per indicated hp-hour, and in an 800-hp turbine 10¼ pounds per indicated hp-hour. From these and other tests, it is reasonable to suppose that the 3,000 and 6,000-kw turbines now under construction will show a considerably reduced steam consumption.

The Choice of Signs in Wattmeter Problems.

BY L. A. FREUDENBERGER.

GIVEN two wattmeters, W' and W'', connected to a three-phase network to indicate power. Each receiving circuit takes power at a phase lag of 45°, and each receiving circuit takes 5 kw. The problem is to find the reading of each wattmeter.

Consider first the delta connection of receiving circuits, Fig. 1:

Let the receiving circuits be represented by A, B and C. Let the three-phase e.m.f's and currents be represented as supplied by the

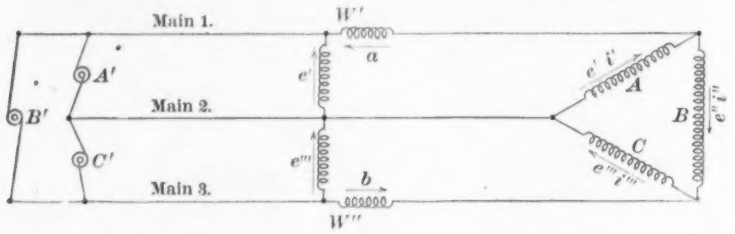


FIG. 1.—CIRCUITS OF DELTA-CONNECTED RECEIVER.

three alternators, A', B' and C'. The e.m.f's supplied by these alternators will all be equal in numerical value and 120° apart in phase. In order to solve the above problem the vector diagram of e.m.f's and currents in the wattmeters must be drawn and this involves the vector diagram of e.m.f's and currents in the three receiving circuits, A, B and C, together with the proper choice of directions of current and e.m.f. through the wattmeter coils.

In the three windings, A, B and C, the positive directions of current and e.m.f. are as shown by the arrows. That is, when a current, i', flows in the winding, A, in the direction shown by the arrow, it will be called a *positive* current. These arrows showing the positive directions do *not* represent the actual distribution of current at any instant; in fact, at no instant can the three currents flow as represented by the arrows. The positive directions through the windings, A, B and C, may be taken in any direction whatever. The positive directions in A, B and C being once determined, the positive directions through the wattmeter coils are then determined. For instance, in determining the positive directions through the shunt and series coils of wattmeter, W', it must be remembered that the positive current, i', in winding A, is produced by the alternator, A' (one phase). Similarly, a positive current, i''', in winding C, is

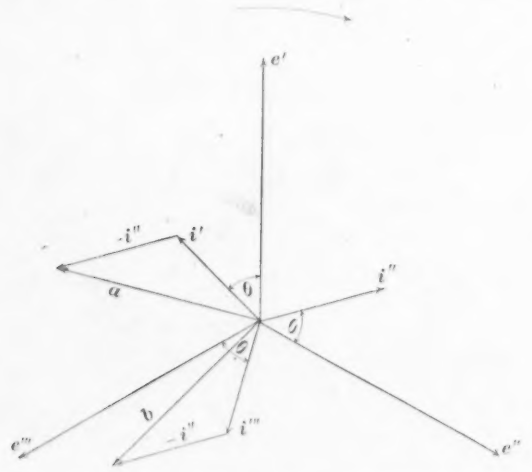


FIG. 2.—VECTOR DIAGRAM FOR DELTA-CONNECTED RECEIVER.

produced by alternator C'. The circuit for the current i''' is from alternator C', over main 3, through C in the positive direction, and return over main 2 to the alternator, C'.

With the delta connection, as shown in Fig. 1, the e.m.f. across the shunt coil of wattmeter W' is the same in numerical value and phase position as the e.m.f., e', across the circuit A. Similarly, the e.m.f. across the shunt coil of wattmeter W'' is e'''. The current, a, in the series coil of wattmeter W' is due to the currents i' and i'' in the windings, A and B. In fact, the current a is the vector sum of the currents i'' and i', taking account of their signs.

The current, b, is the vector sum of the currents i'' and i'''. In order to determine the values and phase positions of the currents a and b, it is necessary to construct the vector diagram of e.m.f's and currents in the three receiving circuits and from these to construct the vector diagram of e.m.f's and currents in the watmeter coils.

The power indicated by wattmeter W' is

$$W' = e'\ a\ cos\ (e'\ a).$$

The power indicated by wattmeter W'' is

$$W'' = e'''\ b\ cos\ (e'''\ b).$$

Starting with the receiving circuits, A, B and C, and going through them in a clockwise direction, the advance is from A to B to C, all in the positive direction. Since the system is balanced and the e.m.f's consequently 120° apart in phase, the diagram of e.m.f's will be as shown in Fig. 2. A vector with its arrow pointing *out* from the center will be considered a positive vector. The advance is from A to B to C and all e.m.f's are in a positive direction through the windings.

The e.m.f's, e', e'' and e''', in Fig. 2, represent the values and phase positions of the e.m'f's in the receiving circuits, A, B and C; e' and e''' will also represent the values and phase positions of the e.m.f's across the shunt coils of the wattmeters, W', and W''.

The currents i', i'' and i''' in the receiving circuits, A, B and C, are 45° behind their respective e.m.f's in phase. From Fig. 1 the current a in the series coil of wattmeter W' is the vector sum of the currents i' and i''. To determine the signs of the currents i' and i'', consider the current a flowing in the positive direction, as indicated by the arrow. One path for the positive current, a, is out from alternator A', over main 2, through A in the positive direction (current i') and return to alternator A' over main 1. The other path for the positive current, a, is out from alternator B', over main 3,

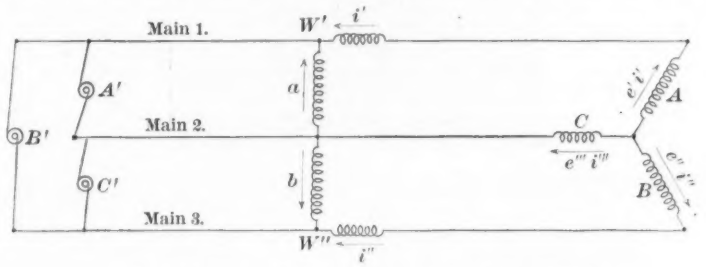


FIG. 3.—CIRCUITS OF STAR-CONNECTED RECEIVER.

through B in the negative direction (current $-i''$) and return to alternator B' over main 1. Consequently,

$$a = i' - i'' \text{ in vector notation.}$$

From Fig. 2 the current a may be drawn in as indicated. The vector $-i''$ is drawn parallel to i'' and in the opposite direction.

From Fig. 1, $\quad b = i''' - i''$ in vector notation.

In determining the signs of i''' and i'' it must be remembered that these currents are produced by the alternators C' and B'.

The triangle of which the sides are i', $-i''$ and a, has the sides, i' and $-i''$ equal and the included angle between i' and $-i''$ equal to 120°. Consequently, the angle between i' and a is 30°. Similarly, the angle between b and i''' is 30°. Consequently, the current a lags $\Theta° + 30°$, or 75° behind e', and b lags $\Theta° - 30°$, or 15° behind e'.

Therefore, wattmeter W' will indicate the power

$$W' = e'\ a\ cos\ (e'\ a) = e'\ a\ cos\ (\Theta° + 30°) = e'\ a\ cos\ 75°.$$

$$W'' = e'''\ b\ cos\ (e'''\ b) = e'''\ b\ cos\ (\Theta° - 30°) = e'''\ b\ cos\ 15°.$$

Dividing one question by the other,

$$\frac{W'}{W''} = \frac{e'\ a\ cos\ 75°}{e'''\ b\ cos\ 15°} = \frac{cos\ 75°}{cos\ 15°} = 0.26795.$$

Since $e' = e'''$ numerically, and $\quad a = b$ numerically.

Also the sum of the two wattmeters will indicate the total power, 15 kw.

$$\therefore \quad W' + W'' = 15;$$

$$\therefore \quad W' = 3.17 \text{ kw}, \qquad W'' = 11.83 \text{ kw}.$$

From the above discussion it may be seen that when the angle of lag is 60° the angle between e' and a will be 90°, the $cos\ (e'\ a)$ will be zero and wattmeter W' will indicate zero; wattmeter W'' will then indicate the total power, 15 kw. When the angle of lag is greater than 60°, wattmeter W' will read negative and the *arithmet-*

ical difference between the readings of wattmeters W' and W'' will equal the total power, or 15 kw.

Consider next the Y connection of receiving circuits, as shown in Fig. 3:

The positive directions of e.m.f. and current through the receiving circuits, *A*, *B* and *C*, are first chosen and may be taken in any direction whatever. As before, these positive directions do not represent the actual distribution of current at any instant; in fact, at no instant can currents flow as shown by the arrows. The positive directions through the receiving circuits having been chosen, the positive directions through the wattmeter coils are fixed. In order to determine the positive direction through the series coil of wattmeter W', consider an instantaneous positive current in winding *A*. Then the current in main 1 must also be i' since only one winding, *A*, is connected to main 1. The circuit for this positive current, i', is out from alternator A', over main 2, through *C*, in a negative direction, through *A* in a positive direction, and returning over main 1 to A', as shown by the arrow. Similarly, the current through the series coil of wattmeter W'' is the same at all times as i''. The positive directions through the shunt coils of wattmeters W' and W'' can now be determined, and are as shown, remembering that a current, i', is produced by alternator A', and a current, i'', is produced by alternator C'.

The vector diagram for the receiving circuits, *A*, *B* and *C*, is now

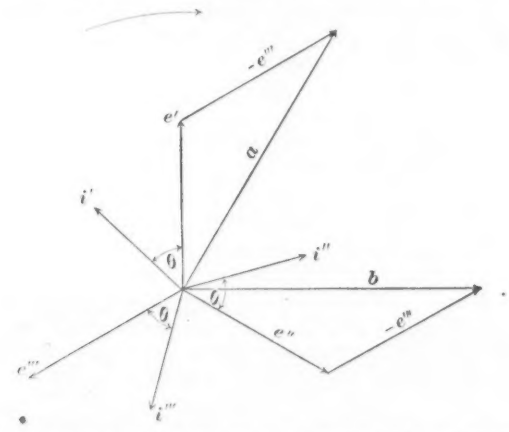


FIG. 4.—VECTOR DIAGRAM OF STAR-CONNECTED RECEIVER.

drawn as shown in Fig. 4 (clockwise rotation from *A* to *B* to *C*, and all positive, since all vectors are *out* from the neutral point).

The currents, i', i'' and i''', lag 45° behind their respective e.m.f's, as shown.

The currents, i', i'' and i''', represent the magnitude and phase positions of the currents in the receiving circuits, *A*, *B* and *C*; i' and i'' will also represent in magnitude and phase positions the currents in the series coils of wattmeters W' and W''. The e.m.f., "a," across the shunt coil of wattmeter W' is the vector sum of e' and e''',. The e.m.f., "b," across the shunt coil of wattmeter W'' is the vector sum of e'' and e''', in both cases taking proper account of their signs.

The reading of wattmeter W' is, referring to Fig. 3,

$$W' = a\ i'\ cos\ (a\ i').$$

The reading of wattmeter W'' is $W'' = b\ i''\ cos\ (b\ i'')$.

From Fig. 3, using vector notation,

$$a = e' - e''',$$
$$b = e'' - e'''.$$

Constructing *a* and *b* on Fig. 4, the angle between *a* and i' is $\Theta° + 45°$, or 75°, and the angle between *b* and i'' is $\Theta° - 45$, or 15°. Then

$$\frac{W'}{W''} = \frac{cos\ 75°}{cos\ 15°}, \text{ as in the delta connection.}$$

The above discussions apply to the case of balanced three-phase distribution. The case of the unbalanced three-phase distribution is similar except that the magnitudes and phase positions of the e.m.f's and currents in the receiving circuits must be known. A vector diagram can then be drawn similar to Fig. 2 or Fig. 4, except that the e.m.f's and currents do not differ in phase by 120° and their magnitudes are not equal.

The Handling of Delinquent Accounts.

By W. H. Winslow.

PERHAPS in no other point of contact with its customers is a public service corporation more likely to make enemies than in its handling of delinquent accounts. This fact was kept in mind in formulating the following plan of handling such accounts, in which plan an effort has been made to avoid both the unnecessary offending of patrons, on the one hand, and on the other a laxity which would be productive of large losses.

Dealing as it does with all sorts and conditions of men, it is, of course, impossible for an electric company to eliminate entirely the "collect or cut out" feature from its collection methods. It is possible, however, to keep this idea somewhat in the background and to regard the use of such methods as a disagreeable necessity. Some of the cut-out notices which the writer has seen would certainly convey the impression that the cutting-out process was enjoyed rather than otherwise. It is worthy of note, also, that the tone of

STATEMENT

SUPERIOR, WIS. JAN 15 1905

Mr. John Jones

1901 27th St

IN ACCOUNT WITH

SUPERIOR WATER, LIGHT & POWER CO.

		NO. MO'S		
GAS REG. NO.	1501	1	6	40
" " "	1502	1	3	60
" " "				
ELEC. REG. NO.	756	1	2	50
" " "				
" " "				
" " "				
WATER REG. NO.	347	1	1	75
" " "				
" " "				
MISC BILLS	Mantles	12/15	1	00
E. & O. E.	TOTAL		15	25

THE ABOVE ACCOUNT IS NOW PAST DUE AND THE FAVOR OF AN IMMEDIATE PAYMENT IS REQUESTED.

FIG. 1.—"A" FORM FOR DELINQUENT ACCOUNTS.

a company's communications to its patrons causes its own employees to exaggerate any brusqueness or high-handedness which the communications may contain.

As a means for determining the delinquents, the forms illustrated in Figs. 1 and 2, *"A"* and *"B,"* have been devised. These forms, arranged alternately, are put up in tablets gummed along the left side, "A" being printed on a rather thin white paper and "B" on a heavier tinted paper. As soon as the discount period has elapsed, and all credits have been posted, statements are made out of all accounts remaining unpaid, "A" and "B" being, of course, made out at the same time by the use of carbon copying paper. They are then sorted alphabetically, the two sheets, "A" and "B," remaining fastened together in pairs. In all cases where the same person has various accounts, all of his statements are transferred to one sheet. It is important that this alphabetical arranging be done carefully,

as the subsequent weeding out of paid accounts is thereby greatly expedited. After all small accounts of, say, less than one dollar, have been weeded out, the statements are turned over to the official who performs the duties of credit man.

The course which has been found most satisfactory in dealing with these notices is first to run through them hastily, removing the "A" portion of such accounts which may require special attention, and noting on the "B" slips the action to be taken. These having been disposed of, the entire lot is gone through carefully, the "A" forms being laid in various piles and the "B" forms being marked as before to indicate the action taken. "M" means that the notice is to be mailed, this being done in the case of accounts of people whose credit is good. "M-N" means that the statement is to be mailed with notice reproduced herewith, this, however, being used as sparingly as possible.

"DEAR SIR:—We regret very much that we have not had a reply to our recent request for remittance. The prompt payment of your bills when due, which we ask of you, is merely what our own creditors require of us. We trust that you will appreciate this, and not compel us to carry into effect an order which has been issued for the withdrawal of water and light supplies. This order will be held for a few days and your prompt reply will save us both trouble and expense. We again assure you that only our own necessities prevent our giving you further time, and believe that you will always find us willing to do anything in reason for the convenience of our customers."

The credit man now has duplicates of all the statements, showing the disposition made of the originals. From these are removed each morning the bills paid during the previous day, and after a proper interval, say four to five days, they are gone over a second time, and in cases where four-day notices were sent, "collect or cut-out" orders (Fig. 3) are made out and turned over to the proper superintendents for execution. In the cases where the statements were mailed by themselves, a so-called second notice is sent out, where it is considered advisable.

DATE JAN 15 1905

NAME John Jones

ADDRESS 1901 27th St

GAS	1501	1	6	40
"	1502	1	3	60
"				
ELEC.	756	1	2	50
"				
"				
WATER	347	1	1	75
"				
"				
PETTY L	Mantles	12/1	1	00
	TOTAL		15	25

FIG. 2.—"B" FORM FOR DELINQUENT ACCOUNTS.

"DEAR SIR:—Herewith please find statement of account which, according to our terms, is now past due. We are not in a position to extend further credit as, in order to meet our own bills promptly, we are compelled to insist on like treatment from our patrons. Kindly let us hear from you within four days, as otherwise an order will be issued to discontinue further credit until bills are settled."

IMPORTANT.

"When service is discontinued on account of non-payment a charge will be made to cover cost of reconnecting."

It is believed that the time taken to carry out the plan here described is well spent, and that it would be wise for both gas and electric companies to give more attention to their "credit departments" than as a rule is done. There are numerous cases where dangerous enemies have been made of pople who, through some oversight or unexpected absence, had failed to pay with their usual promptness, on account of a cut-and-dried method of sending out peremptory notices. In the case of a lighting company such mistakes may not have the effect of loss of patronage such as would result in a competitive business, but the accumulative effect is likely to be painfully apparent when a municipal ownership agitation is started, or the renewal of a franchise asked for, or an opposition company projected.

Superior Water, Light & Power Co.

....., 190....

No. 299

.....

.....

DEAR SIR:

Your account being past due and no attention having been paid to our request for a settlement the bearer has been instructed to either collect from you the entire balance due as below or to.....

.....

This is done not because we doubt your ability to pay but because our business with its thousands of small bills can only be conducted on a cash basis and we are compelled to insist on prompt monthly settlements in order to meet our own obligations. We trust that you will appreciate our position and in future pay all bills promptly each month. Any errors or cause for dissatisfaction should be reported at our office, where they will receive prompt attention.

Very respectfully yours,

Superior Water, Light & Power Co.

..... $.

..... $

..... $

..... $

..... $

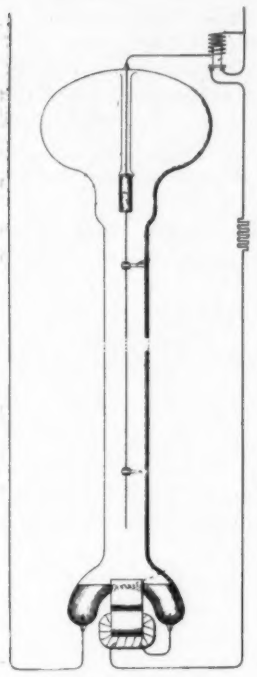
FIG. 3.—FORM FOR "COLLECT OR CUT-OUT" ORDERS.

Profanity and the Telephone.

Mr. Herbert Laws Webb, in a recently published book entitled "The Telephone Service," relates that in a certain city in this country a carting contractor was so uncontrollably profane in talking to central that his service was cut off, and subsequently renewed only upon insertion in the contract of a clause that the subscriber himself was not to use his own telephone. Another method in dealing with the profane kicker was applied to a clerk in a government department, who made a practice of coarsely abusing the telephone operators on every occasion. Finally, the manager had the line connected to his own desk and on the first opportunity he took down in shorthand all the abusive remarks that the clerk thought he was addressing to the unfortunate operator. A verbatim copy was made and sent to the employer with an intimation that the service would be cut off if the offender continued to use the telephone. The clerk lost his position.

Starting Device for Mercury Vapor Lamps.

The accompanying illustration shows a type of starter for vapor lamps patented by J. T. H. Dempster February 7, 1905, and assigned to the General Electric Company. The object to be accomplished is to ionize the mercury vapor so as to break down the initial high resistance in the vapor tube, thereby allowing to flow the main illuminating current which serves to cut out of circuit the auxiliary starting devices. As seen in the figure, the lower bifurcations of the tube are filled with mercury to a depth such that the mercury just bridges over the portion separating the bifurcations. An electromagnet is so disposed that, when energized, its flux cuts across this thread of mercury. Upon the application of current to the lamp circuits, the field due to the electromagnet acting upon the current passing through the section of mercury produces a repelling action thereon, and has the effect of causing the separation of the mercury thread. The mercury vapor thus generated becomes conducting, and an electric arc immediately passes up the tube to the positive electrode of carbon or graphite. In this operation the passage of the arc is greatly assisted by the presence of the carbon filament which is suspended from the electrode (anode) and extends down through anchoring devices to within sufficient proximity to the body of mercury. When this state of affairs is reached, current which reaches the anode energizes the cut-out magnet (seen at the top of the illustration) which opens the circuit to the auxiliary deflecting magnet. When the vapor becomes thoroughly ionized its resistance is of such low value that almost no current passes through the carbon filament.



DEMPSTER VAPOR LAMP.

New Telephone Patents.

A NEW TELEPHONE REPEATER.

The telephone repeater has again appeared, this time in a most encouraging form. It has for a long time been known just how to proceed to make an instrument which will receive telephone currents and magnify them many times. With these instruments, however, the magnification is accompanied by a distortion such that the magnified currents fail to produce desired results.

The inventor of the new apparatus, W. W. Jaques, has approached the repeater from this standpoint of distortion, and he has found that there are certain governing conditions which determine the character of the distortion. For instance, with a telephone-microphone type of repeater, he has found with a light pressure upon the diaphragm, high pitches will be magnified to far more than their true proportionate value in the composite tone. On the other hand, with a heavy pressure upon the diaphragm, the low pitches receive the excessive magnification. The evident result is, of course, an endeavor to combine these two effects in a single apparatus and in proportion such that each will cancel the other.

To accomplish this, the received currents, approaching the repeater, must be only slightly distorted, or better, be distortionless, This condition can be fulfilled under proper conditions of line, such as have been heretofore described. The received currents are conducted into a magnifying relay with lightly poised diaphragm. Then the magnified current is led to a relay with a diaphragm under pressure such that the distortion is largely cancelled by the reintroduction of the low notes upon a proper scale. The resultant slightly distorted current is then forwarded to the receiving station. While this gives the rudiments, the method of connection of the apparatus to make it operate both ways upon a single pair of wires and yet without singing or buzzing is of importance. Fig. 1 shows this in diagrammatic form. At $t_3\,t_5$ is shown the apparatus for speech, from T_1 to T_2, and at t_6 and t_4 is that for speech in the reverse direction. At $A\,t_1$ is an artificial line bearing a definite relation as to its electrical properties to the real line from T_1, and at $A\,t_2$ is an artificial line based upon the real line to T_2. Suppose a current coming from T_1. This reaches r_3 and r_7 and a portion passes on to and through the artificial line, while a part passes out to the induction coil, Ic_6. The relay, t_3, being affected, advances a multiplied current to t_5. This latter again multiplies it and corrects the distortion. This final current, being repeated and magnified

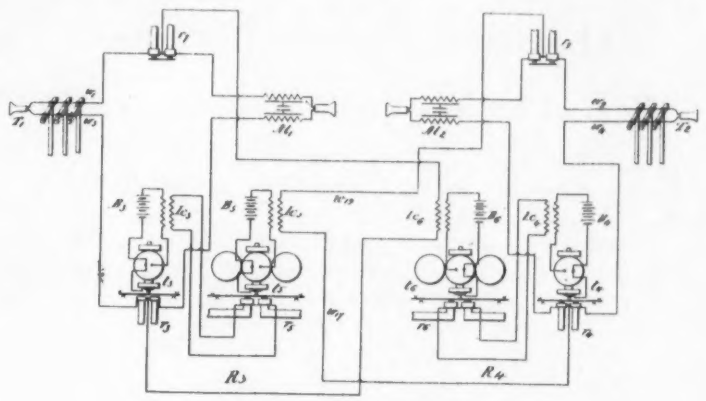


FIG. 1.—JAQUES TELEPHONE REPEATER.

by the induction coil, Ic_5, is advanced to a mid-point in the two receivers, r_4 and r_8, and here divides. Part proceeds out upon the line T_2 and part through the artificial line. These currents must, however, cause a net resultant effect of zero upon the instrument, t_4. If this were not so, t_4 would impress its magnification to be in turn effective at t_6 and so on back to the originating line. Here it would again become effective upon t_3, being again multiplied, passing around and around, until the instrument gives out a howl only. The means for preventing this, as above, is the location of the midpoint in the receiver, r_4, so that the division of the currents between lines T_2, real, and $A\,t_2$, artificial, will cause a differential effect of zero.

ANTISEPTIC DEVICES.

Two antiseptic devices for transmitters have been patented recently. These are very dissimilar. The first is the invention of S. E. Williams, of Boston. It consists of a cone of fibrous material such as paper, which is suspended in an annular holder of rubber. This latter is adapted to snap over the transmitter mouthpiece and hold the paper cone in suspension in it. The base of the cone may be cut off and closed with a corrugated diaphragm.

W. K. Brackett, of Alameda, Cal., has patented the second of these devices. This consists of a clamp for the mouthpiece, which is so designed that a perforated metal antiseptic container may be suspended from it well within the mouthpiece. Fig. 2 shows both devices.

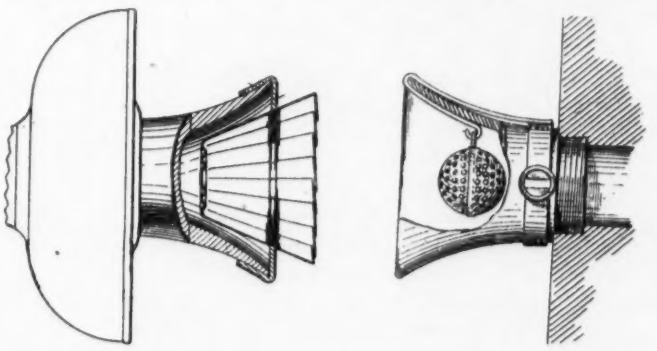


FIG. 2.—WILLIAMS AND BRACKETT ANTISEPTIC DEVICES.

ELIMINATION OF WIRELESS MESSAGE DISTURBANCES.

Mr. John S. Stone, of Boston, has patented the use of a discharger for telephone lines, which shall be of high impedance to currents of telephone frequency, but of low impedance to currents of the frequency of the waves of transmission of wireless telegraph or telephone messages. The most obvious discharger to meet this requirement is a circuit including a condenser of very low capacity.

PART SELECTIVE PARTY LINE SYSTEM.

A twelve-party selective system is the subject of a patent granted to C. B. Smith, of New York City. The system requires three

wires for each line. The selection is accomplished by means of polarized impulse currents, polarized and non-polarized relays and biased bells. The bells are legged off either of two of the wires, to ground, while the relays are connected between ground and the third wire. The system is cleverly worked out, but the use of a three-wire line would seem a fatal objection.

Letters to the Editors.

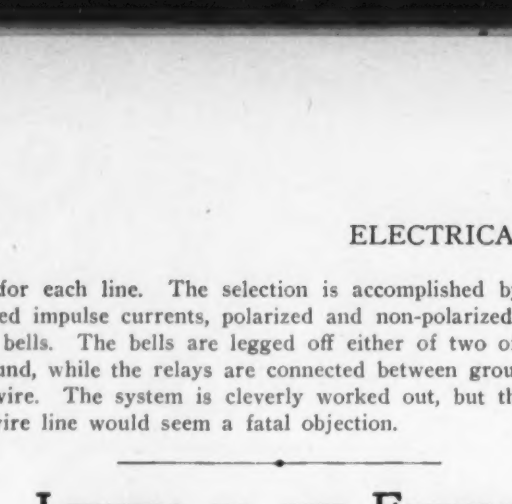
Cost of Electric Power to Consumers.

To the Editors of Electrical World and Engineer:

Sirs:—I have been much interested in the articles you have been publishing from time to time on electrical generating plants. All these articles, however, seem to have been written from the engineers' and station managers' standpoint, with little or no reference to the consumer. It seems to me that it would be of interest, not only to prospective consumers but to power station managers also, if writers would include, where possible, information on the following points:

1. How much less electric power is actually used and paid for than when the consumer used a steam engine? There must be considerable saving in transmission losses from the steam cylinder to the tool.
2. What is the saving in cost to the consumer?
3. What is the maintenance cost of electric motors and their connections as compared with steam engines and connections?
4. How much does electric power save in labor over steam power?
5. What is the difference in the insurance values of the two powers?

In your issue of January 21, page 161, is a table showing the electric power charges of the Fife Electric Power Company (Scotland). While this power is to be furnished from a steam generating plant, it seems as if the rates per kw-hour are rather high. I enclose a diagram plotting these rates together with the rates



COST OF ELECTRIC POWER.

charged by the Cataract Power & Conduit Company. Of course, the latter derives its energy from water power, but it would seem natural that any power company in disposing of its product would try to earn as much as possible and keep under the cost of steam power.

On the diagram the line showing the cost of power in Buffalo does not include the $1 per kw of power installed, but were this included the rate would remain less than one-half that charged by the Fife Electric Power Company. At the upper part of the diagram is figured the size of the motor necessary to install to obtain a given number of kw-hours per month, using different power factors.

The load factor as used on the diagram is the total number of kw-hours per month as indicated by a meter, divided by 730 times the kilowatt capacity installed. In this connection it seems to me that a definite meaning should be agreed upon as to what constitutes load factor. I notice in many articles that the load factor appears to be taken as the kw-hours divided by total number of hours, times the peak load during that interval. Taking it on this basis the load factor for the same motor at different months or weeks is a variable one. I think the load factor as defined by myself is less variable. Of course, it is open to the criticism that it is possible to develop in the motor, for short periods, an output considerably in excess of the nominal rating of the machine. In this connection it might be advisable to say that the capacity of the motor is the maximum of which it is capable when run for ten hours or more, and without increasing the temperature of the motor beyond a certain amount over the temperature of the room in which it is installed.

On the diagram enclosed I have plotted, using four load factors, four lines giving the cost per kw-hour, as taken from the power rate card of the Cataract Power & Conduit Company. This shows the desirability of a high load factor. Most industrial plants have a load factor between 20 and 40 per cent.

Baltimore, Md. Charles L. Jones.

Power Factor Indicators.

To the Editors of Electrical World and Engineer:

Sirs:—In Mr. Richardson's article on "Power Factor Indicators" appearing in your issue of December 24 are several statements, the correctness of which I would like to question.

In his mathematical treatment of the General Electric Company's instrument it is first stated that the deflection of the needle is the ratio of watts, $\frac{W_1}{W_2}$, where W_1 and W_2 are the watts that would be measured by the two wattmeter method. I take it he means to say that the angle of deflection and the ratio of watts are proportional.

Let us consider some of the values the ratio $\frac{W_1}{W_2}$ can have, by giving various values to the angle of lag or lead. When ϕ equals zero, $\frac{W_1}{W_2}$ will equal unity. Corresponding to this the deflection of the needle is zero, if we measure deflection from the point where the needle would stand when ϕ equals zero.

Now, as the angle of lag increases, the ratio and also the deflection increase. But when ϕ becomes 60° the ratio goes to infinity. While ϕ passes from 60° to 90° the ratio comes up from negative infinity to —1.

Next, let ϕ have negative values; that is, consider the current as leading instead of lagging. As ϕ varies from zero to —60° the ratio of watts decreases from unity to zero. For values of ϕ between —60° and —90° the ratio is negative.

It is readily seen that the needle cannot keep up with such values as these, and that a scale on which it might indicate such values would be a very peculiar one indeed.

From the equation giving the ratio of watts in terms of ϕ, Mr. Richardson obtains his equation (5), which is only a step toward the solution for *cos* ϕ, since *sin* ϕ remains on the right-hand side. Why not go farther and obtain

$$\cos\phi = \sqrt{\frac{1}{1 + 3\left(\frac{W_1 - W_2}{W_1 + W_2}\right)^2}}$$

From equation (5), of the article referred to, the deduction is made that any change in the watts will cause a change in the deflection in accordance with the *cos* ϕ. This cannot be correct. The amount of the deflection does not appear anywhere in the equation, nor, so far, is it known in terms of any quantity therein.

It is not very clear what Mr. Richardson means by the term "indicate." If the potential coils indicate the watts they must do so through their deflections, for to rotate or deflect is all they can do. How, then, can the coils, since they are fixed to the same shaft, indicate two independent quantities?

As far as I can see, Mr. Richardson's equations connect the angle of lag or lead with the deflection in no way whatever.

I would like to submit the following as a mathematical analysis of the operation of the instrument:

I will make use of Mr. Richardson's notation as far as convenient. In addition, let i_1 and i_2 be the currents in the potential coils due to the impressed e.m.f's, E_1 and E_2. The potential coils possess some inductance; also, there is a mutual induction between all three coils, and this varies as the coils rotate. However, the high resistance of the potential coils makes the angles of lag of the currents

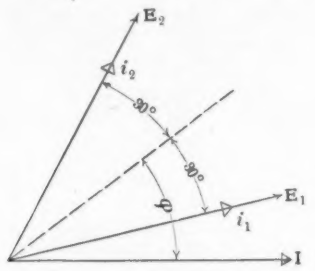


FIG. 1.—PHASE POSITION OF CURRENT AND ELECTROMOTIVE FORCES.

in them very small. We may, therefore, consider the currents as being in phase with the impressed e.m.f's.

Let i_1' and i_2' be the components of i_1 and i_2 in phase with I. Referring to Fig. 1, we have:

$$i_1' = i_1 \cos(\phi - 30^\circ)$$
$$i_2' = i_2 \cos(\phi + 30^\circ) \qquad (1)$$

As the instrument is constructed, the series coil completely surrounds the potential coils, therefore the potential coils are immersed in a uniform alternating field due to the current I.

Fig. 2 is diagrammatic and is a view of the quantities when looking at the instrument in the direction of the shaft. A_1A_1 and A_2A_2 are potential coils, 1 and 2, respectively. The uniform field due to the series coil is taken in the horizontal direction. The four vertical arrows indicate the directions of the forces acting on the conductors. It is the components of these forces perpendicular to the radii drawn to the center, O, that produce turning moments. Where the cross-section of the winding is rectangular it can readily be shown that the sum of the turning moments of a coil is the same as if all the conductors were concentrated at the center of the rectangle. The coils are identical, so let r be the common radius from the center of the rectangle to the center, O.

Let Θ be the angle between the coils. When ϕ equals zero it is evident the bisector, OC, of Θ will occupy the vertical position, for the currents in the coils are equal. When ϕ receives some positive value, i_1' becomes greater than i_2' and the coils rotate through an angle, α. Since the force acting on each conductor is proportional to the product of its current and the current I, we have for the total turning moments on the coils,

$$-k\,r\,I\,i_1' \sin(\tfrac{1}{2}\Theta - \alpha)$$
and $$k\,r\,I\,i_2' \sin(\tfrac{1}{2}\Theta + \alpha).$$

Equating their sum to zero and transposing, we have

$$i_1' \sin(\tfrac{1}{2}\Theta - \alpha) = i_2' \sin(\tfrac{1}{2}\Theta + \alpha)$$

or
$$\frac{i_1'}{i_2'} = \frac{\sin(\tfrac{1}{2}\Theta + \alpha)}{\sin(\tfrac{1}{2}\Theta - \alpha)} \qquad (2)$$

But from equations (1), equating i_1 and i_2,

$$\frac{i_1'}{i_2'} = \frac{\cos(\phi - 30^\circ)}{\cos(\phi + 30^\circ)} = \frac{\sin(60^\circ + \phi)}{\sin(60^\circ - \phi)}.$$

Therefore, we have:

$$\frac{\sin(\tfrac{1}{2}\Theta + \alpha)}{\sin(\tfrac{1}{2}\Theta - \alpha)} = \frac{\sin(60^\circ + \phi)}{\sin(60^\circ - \phi)}. \qquad (3)$$

From equation (3) is readily deduced,

$$\tan\phi = \sqrt{3}\cot\tfrac{1}{2}\Theta \tan\alpha. \qquad (4)$$

This is the equation giving us the angle of lag or lead in terms of the deflection. Values of α can be substituted in it to get corresponding values of ϕ, and so be used in laying out a scale on which ϕ or $\cos\phi$ will be indicated directly.

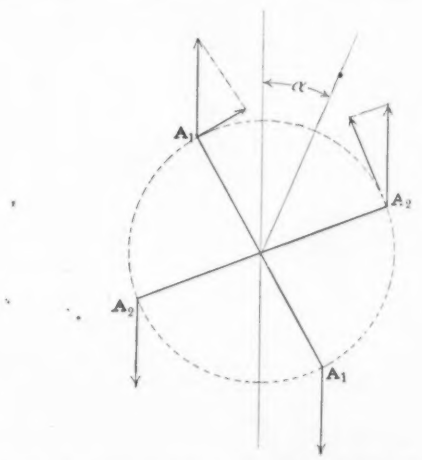


FIG. 2.—REPRESENTATION OF FIELD AND TORQUES.

If the coils are set so that Θ equals 120°, the coefficient in equation (4) reduces to unity and the equation itself becomes

$$\tan\phi = \tan\alpha, \qquad \text{or} \qquad \phi = \alpha.$$

It is now only necessary to lay off a cosine scale on the arc and the readings will be the power factor direct.

NEW YORK, N. Y. W. F. SHAW.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Insulation of High-Tension Coils.—HIGHFIELD.—An account of some trouble experienced with the insulation of armature or other coils for high-tension apparatus. A certain 10,000-volt alternator broke down on one or two occasions; in the same the copper was insulated from the core plates by means of a solid mica or micanite tube, having a dielectric strength capable of resisting at least four times the working pressure, while the ends of the tubes were carried out quite clear of the frame, so that there was no chance of sparking taking place from the ends of the coils to the frame. The coils were insulated between turns with varnished cotton braiding; they were formed by winding the ribbon of which the conductors consist, through two tubes; the ends of the coils, where they emerged from the tubes, are protected by strips of mica and wrappings of ordinary Empire cloth with prespahn, and finally black-taped to give some mechanical protection, the workmanship being all that could be desired. Upon examining a coil by splitting open the tube, it was at once apparent that serious corrosion had been taking place, the braiding being practically destroyed, and the copper covered with a green deposit. An inspection of the ends of the coils showed that the Empire cloth near the tube was completely rotted, being quite damp and having a strong acid reaction. The green deposit was found to be nitrate of copper; there also appeared to be a certain amount of free nitric acid present. In the Empire cloth at the ends of the coils sulphuric acid was found. The author concluded that the nitric acid was formed by brush discharges taking place on the inside of the coils from the copper to the mica and, with the nitrogen from the atmosphere and moisture from the air, producing nitric acid. To test this, one of the tubes was carefully cleaned, and a strip of bright copper gauze covered with pure filter paper was placed inside the tube, the outside of the tube being covered with tin-foil connected to earth, the copper being connected to the supply of 10,000 volts; the paper was not specially dried. Ozone was produced in considerable quantities at once, and in about

one week a considerable amount of green deposit of nitrate of copper was formed on the copper gauze, and free nitric acid on the filter paper. The author concludes that no air whatever should be admitted between the copper, iron and insulation. He recommends to fill in the whole of the space from the copper to iron with insulating material so as to entirely exclude air. In an editorial note it is thought that this would be rather "messy," especially on the overloads and after long runs; the remedy should rather be sought in an impervious insulating material for the windings themselves.—Lond. *Elec.*, January 27.

Small Dynamos.—POOLE.—A continuation of his illustrated serial on the design and construction of small dynamos and motors. In this installment the author deals especially with the design of the field magnet and winding.—*Am. Elec.*, January.

Repulsion Motor.—SCHNETZLER.—The conclusion of his illustrated article on the theory and predetermination on the Deri motor, the principal features of which were noticed in the Digest last week. The author summarizes the advantages of this type and describes a simple and accurate method for calculating repulsion motors.—*Elek. Zeit.*, January 25.

Changing Magnet Windings for Different Voltages.—An article, accompanied by two tables, by means of which it becomes an easy matter to rewind a magnet coil for some voltage other than the one for which the magnet was originally wound, keeping the magnetizing power of the coil practically unchanged.—*Am. Elec.*, February.

Average Length per Turn of Wire in Magnet Coils.—An article with a table giving the mean length per turn of wire in round magnet coils, the diameter of coil bobbin to be ⅛ in. larger than the magnet core. The table has core diameters plus coil depths from ¾ in. to 16 in. in steps of sixteenths.—*Am. Elec.*, February.

Refilling and Repairing Commutators.—WEEKS.—An illustrated article containing many practical and valuable hints on refilling and repairing commutators.—*Am. Elec.*, February.

LIGHTS AND LIGHTING.

Tantalum Lamp.—In the discussion of the Berlin Elec. Society paper by Bolton and Feuerlein (ELECTRICAL WORLD AND ENGINEER, January 28), W. von Siemens, the head of Siemens & Halske Co., remarked that more than a year ago his company was in a position to produce and exhibit suitable 110-volt tantalum lamps, but the company decided not to publish results before a reliable production of at least 1,000 lamps per day would be reached. This figure represents the present situation. He stated that a large number of lamps have been practically used with good success in private installations since last spring. This lamp is now to be placed on the market.—*Elek. Zeit.*, January 26.

Theatre Lighting.—A fully illustrated description of the electric installation of the London Coliseum. There are four three-wire services for the lighting and power, taken from the ordinary network, but in the event of failure of this source the entire supply can be derived from special theatre mains. When fully lighted, the stage requires about 2,000 amp. This is made up of 3,000 lamps of 32 cp, 24 arcs, one 80-amp. arc for a biograph, nine 50-amp. arcs for special stage effects, and three arcs in the front of the house. All the incandescent lighting is at 200 volts, and the arc at 100 volts. There is also considerable power load, but the peak is of not more than a few minutes' duration—viz., the length of time required for the great Derby scene. This takes place four times a day, and for the rest of the time there is very little power required at all, except for turning the stage slowly in order to bring fresh scenes before the proscenium.—Lond. *Elec.*, January 27.

Train Lighting.—An illustrated description of the Aichele train lighting system used by Brown, Boveri & Co. The characteristic feature which distinguishes this system from most others is that the dynamo is driven at constant speed and the change of the voltage corresponding to the instantaneous condition of the battery is obtained by an automatic shunt regulator.—*Elek. Zeit.*, January 26; Lond. *Elec. Eng.*, January 13.

POWER.

Small Size Coal Used in Power Plant.—MOSES.—An article pointing out the economy due to the use of small size coal in electric power plants. If the expenditure in a plant is at a rate of $30 per day at present for number 1 buckwheat coal it can be reduced to between $24 and $25 by the use of No. 3 buckwheat under forced draft. There are two methods of burning this small coal, both of which require a forced draft. It has been found by experience that, in order to burn the small size anthracites it is necessary to have a draft of one ounce pressure per square inch in order to secure a proper mixture of the air and coal. The best method, for small plants of 500 hp or less, requires a steam blower to produce the necessary pressure in the ashpit. The main requisite is to have an adjustable rate of steam emission from the nozzles so that when the steam pressure falls the opening can be made larger, and the same quantity of air discharged into the ashpit. The second method employed for plants of over 500 hp requires a centrifugal fan with galvanized-iron ducts carrying the air to the ashpit. The fan system is more economical in its use of steam, but takes up a great deal of space, and the ducts are bulky and difficult to install in a plant already in operation. Of importance next to, if not greater than, that of the apparatus for producing the draft and delivering the air, is the system of grates. Here again two distinct principles are met; the first, largely used with steam blowers, consists of a heavy, almost solid grate with small openings, spaced three or four inches apart. With grates of this character the ashes do not fall into the ashpit at all, but are drawn out through the fire doors, the good fire being pushed back onto a so-called cleaning platform. The other system of grates is built on a principle exactly contrary to this, and as much air space as possible is left. Grates have even been made of wire mesh. This type of grates is used almost exclusively where the pressure is obtained by the use of a centrifugal fan or blower, or when the natural draft is sufficient.—*Eng'ing Mag.*, February.

Electricity in Mines.—PHARO.—A fully illustrated description of an electric mining plant near Silver City, Idaho, which is the first high-tension transmission plant built in America by a mining company for its own use. Since the cost of coal was $17.50 per ton and wood $9 per cord at the time when the installation was commenced, it was decided to erect a hydro-electric plant. The plant comprises four 72-in. vertical turbines, each capable of developing 759 hp on a 17-ft. head. The turbine shafts revolve at 77 r.p.m., driving the head shafting at 230 r.p.m. The station equipment consists of three 300-kw alternating-current generators of the revolving field type They are driven by 44-in. belts at a speed of 514 r.p.m., delivering a two-phase current of 7,200 alternations per minute at 500 volts. Exciting current is supplied from two 15-kw, direct-current generators at 125 volts. The exciters are also belted to the head shaft, the armatures revolving at 600 r.p.m. For transmission the voltage is raised to 22,000. The main transmission line is 27 miles long to the distributing station at Dewey, the line being transposed twice, giving three sections of 9 miles each. From Dewey sub-station one line runs to Black Jack mine sub-station 1½ miles away, and another to the Blaine mine sub-station, 4½ miles distant. With the exception of the lighting circuits, the secondary distribution is three-phase. All of the step-down transformers are similar. The line loss being approximately 10 per cent., or 2,200 volts, these transformers are arranged to reduce from 22,000 volts to a series of voltages ranging from 409 to 480 volts; in addition, taps are brought out to give 110 to 220 volts for the small amount of incandescent lighting.—*Cassier's Mag.*, February.

Electric Power in Mines.—An illustrated article on some electric winding plants in German mines. For some of the largest installations the "Koepe" pulley has been very successfully employed in conjunction with electric working. It consists of a grooved pulley of large diameter mounted on the shaft coupled to the winding motor; the winding rope passes around the pulley and over the pithead gear outside the winding shed, and is thence attached to the cages, the weight of the rope being balanced by the tail rope on the cages. It forms thus an endless system. The arc of contact of the rope on the Koepe pulley is so chosen that the maximum loads occurring are lifted by the friction alone between the rope and pulley, an ample safety factor being allowed for. It has been found possible working this system electrically to reduce the weight of the winding pulley to about one-half the weight of the drums usually required for steam winding plants. The winding plant at one mine is described in detail, which deals with an output of 100 tons of coal per hour, mined from a depth of 2,310 ft.; the installation was designed on the three-phase system with liquid resistance control for the winding motor. Another installation described uses a combination of three-phase and continuous current in form of the

Ilgner system, which was recently noticed in the Digest.—Lond. *Elec.*, January 27.

Typical French Hydro-Electric and Transmission Plant.—GUARINI.—An illustrated description of the generating station at Champ. The plant is situated at the junction of the Drach and Romanche Rivers and the power is used exclusively for transmission. Current at 2,600 volts is distributed to sub-stations, of which there are eleven, and these sub-stations step down the voltage to 2,000 or 1,000 volts, according to the locality. Secondary lines serve the stations of the subscribers. All of these stations are constructed in the same way and consist of small kiosks of masonry three meters square in general, and surmounted with a tower which serves as an entrance for the primary lines and an exit for the secondary lines. The total efficiency of the station, after a transmission of about 31 miles and a double transformation, is 58 per cent. The Champ station is intended to furnish energy exclusively for motive power to the diverse industries installed in the valleys of the Fure and Morge Rivers. The rates for one horse-power year are $25 for a 12-hour day and $30 for a 24-hour day load.—*Am. Elec.*, February.

Hungarian Power Plant.—PULUJ.—An illustrated description of the Hohenfurth hydro-electric plant which supplies 2,800 hp of electrical energy to the Spiro paper and pulp mills and 1,100 hp to nearby towns. There are three 2,500-kw, three-phase generators running at 420 r.p.m. and producing three-phase currents at 15,000 volts at a frequency of 42 periods per second. The high tension is reduced to 300 volts in transformer sub-stations. The installation, and especially the hydraulic part of it, is described in detail.—*Zeit. f. Elek.* (Vienna), January 22.

Small Electric Motors.—KIMBALL.—The first part of an illustrated article on the widening use of small motors with special reference to American practice. The author describes the use of motor-operated conveyors for unloading fruit along the Southern Atlantic seaboard, the use of motor-driven hoists for the discharge of vessels, and the use of electric motors in connection with the oyster trade at Norfolk and for operating organ pipes, ice-crushing machines and refrigerators.—*Cassier's Mag.*, February.

Motor Equipment of Existing Machine Tools.—HANCHETT.—When a machine tool and an electric motor are designed together, well-known principles of machine design can be applied and uniformly satisfactory results produced. Occasionally, however, the equipment of belt-driven machinery presents itself, and the practice that it is wise to follow in such cases sometimes differs materially, since many considerations enter to influence the design. The author describes many motor equipments of existing machine tools, rigid mechanical connections being the only ones considered.—*Am. Elec.*, February.

California Water Power Plant.—A long and fully-illustrated description of the works of the American River Electric Company as a typical American hydraulic and transmission plant.—*Am. Elec.*, January.

Gas Power.—Very long and fully illustrated descriptions of gas producer systems and different types of gas engines; the main part of this number is devoted to this subject.—*The Engineer*, January. A German paper by Wendt on experiments with gas producers and a German address by Strack on his experience with large gas engines are translated and fully illustrated in *Iron Age*, of January 19.

Gas Power.—PERKINS.—An illustrated article on the use of producer gas and of blast furnace gas for the operation of gas engine electric plants in chemical and metallurgical works.—*Electrochem. and Met. Ind.*, February.

Cranes.—HORNER.—An illustrated article on various special forms of cranes.—*Cassier's Mag.*, February.

TRACTION.

Electricity in Railroad Terminal Improvements.—An article pointing out that the use of electricity by steam railroads in the development of territory adjoining great cities appears to be a necessity for the proper development of the future traffic of the companies, particularly in localities like New York. In electrifying railroads it is usual to lay stress only on the cost of making the changes from an electrical standpoint, but to say very little about the cost of other changes that must be made coincident with the change of motive power, for instance the necessity of abolition of all grade street crossings, the reconstruction of platforms, etc. The very large increase in interest charges in connection with the electrification of steam traffic on railroads serving large centers of population, bars any opportunity of a reduction in annual cost of operation, so that it is necessary to overcome the increase of fixed charges by increase of business. Suburban commuter traffic should be encouraged with the idea of securing an increased long-haul passenger and freight business. Finally the ability of electricity to make feasible the increase in capacity of terminals is pointed out.—*Eng'ing Record*, January 28.

Three-Phase Locomotives.—VALATIN.—The first parts of an illustrated description of the new electric locomotives of the Veltellina road. They are designed for two main speeds, one for 60 to 70 and the other for 30 to 35 km. per hour. The locomotives are driven by three-phase motors at 3,000 volts, the frequency being 15. The locomotive has two motors; both are equal and are twin motors, combining a high-tension motor with a low-tension motor; the latter is used only in cascade connection for the lower speed.—*Elek. Bahnen.*, January 10 and 21.

Electric Trolley Omnibus Lines.—WALSH.—A brief illustrated article on electric omnibuses, not running on rails, but receiving the current from an overhead line.—*Cassier's Mag.*, February.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Municipal Lighting Plant.—An illustrated article describing the electric lighting and power system of Bluffton, Ind. The city owns its water works and for several years past has operated in connection with the water works a series arc light system. Up to the winter of 1902-3, natural gas existed in sufficient quantity to supply all local requirements for light and heat, but the supply becoming less it became expedient for the city to build a modern plant to provide electricity for light and other purposes. Three-phase currents with a frequency of 60 cycles and a potential of 2,200 volts are generated. The street lighting service is taken from one of the phases, this phase being used exclusively for this work. Enclosed arc lamps are used. All current is sold by meter, the price to the majority of customers being 10 cents per kilowatt-hour. The plant began operations in March, 1903, giving a day and night service. After six months of operation the incandescent load was more than doubled.—*Am. Elec.*, February.

German Central Station.—COLLISCHOON.—The first part of an illustrated description of the Wiesloch station, which supplies 22 towns in the neighborhood with electric light and power and also furnishes current for a tramway line. The total connections are at present equivalent to 22,784 incandescent lamps of 16 cp. Since it appeared at the beginning that the current would be used mostly for lighting, the single-phase system was selected.—*Elek. Bahnen.*—January 10.

Motor Balancers.—APPLETON.—An article, with diagrams of the connections, on the installation of motor balancers for three-wire systems.—*Am. Elec.*, January.

Distant-Control Switches.—WARRILOW.—The first part of an illustrated serial on distant-control switches and their lay-out in stations.—Lond. *Elec. Eng.*, January 6, 13, 20, 27.

Direct-Current Distance Switches.—An illustrated description of a German remote-control switch for direct current.—*Am. Elec.*, February.

ELECTROCHEMISTRY AND BATTERIES.

Resistance Furnace for Crucibles.—FITZ GERALD.—A fully illustrated article, giving detailed instruction for constructing a resistance furnace for crucibles. The author emphasizes that one of the most important considerations is efficient heat insulation. Many experiments and investigations can be conducted with furnaces using 20 kw or less. If an alternating current which is more satisfactory is used it will probably be brought to the furnace room at high voltage, and if so a transformer should be used which can be connected up so as to give two secondary voltages. If possible, a regulating device should be used in connection with the transformer, so that a considerable range of current and e.m.f. can be obtained. If only an ordinary transformer is available, giving two voltages, it is convenient to have it connected so that 110 or 55 volts can be obtained. A double-throw switch for that purpose is described and illustrated. In experimenting even with so small a furnace as one using 20 kw, it is well to have a good-sized bench for the work, the construction of which is described. The author then discusses in detail the method of erecting a small furnace for heating crucibles, embodied in a granular carbon resistance material. The author gives complete instructions for providing absolutely uniform heating

in a resistance furnace for heating simultaneously a number of crucibles.—*Electrochem. and Met. Ind.*, February.

Technical Chemistry.—WALKER.—The conclusion of his paper on some present problems in technical chemistry. The author refers to the possible use of cellulose as a raw material from which to make food; this renders more acute a problem which is to-day clamoring for solution, namely preservation of our forests. In addition to our annual supply of 4,000,000 of tons of paper stock, we depend upon the forests for our supply of acetic acid, methyl alcohol and acetone. Technical chemistry can do much for the conservation of the forests, and along many lines the time for action has come. The synthesis of India rubber presents to-day from at least the technical side, one of the most promising problems in chemistry. The author then discusses several cases of the utilization of trade wastes and then discusses briefly the application of electrochemical methods in chemistry. "What the application of electricity will do for technical chemistry in the future can be predicted only by estimating the results of the past. In many fields it is practically virgin soil over which only pioneers have trod and which is still waiting to be tilled." After some remarks on catalytic action the author discusses the training of technical chemists.—*Electrochem. and Met. Ind.*, February.

Calcium.—GOODWIN.—A fully illustrated account of experiments for producing metallic calcium by electrolysis of fused calcium chloride; the cathode is gradually raised while calcium is deposited at its end. The furnace is described and illustrated. "The solid metal can be worked like other metals and is much more stable than imagined." The specific gravity is 1.5 at 29° C., so that it is only 4/7ths as heavy as the light metal aluminum. If wires of equal diameter and length are compared, calcium is the fifth best conductor of electricity, being surpassed by silver, copper, gold and aluminum. For wires of equal weight and length the order is entirely different, calcium being second. Calcium is about as hard as aluminum.—*Electrochem. and Met. Ind.*, February; from *Proceedings Am. Phil. Soc.*, Vol. XLIII, No. 78.

Electrolytic Recovery of Tin.—GELSTHARP.—A description of an experiment with an aqueous solution of pure sodium hydrate and tin electrodes. When the current was turned on, the clean, bright tin anode at first became thinly coated with a black or brown oxide, insoluble in sodium hydrate. By reversing the current or making contact with iron, this oxide is reduced to metal and a roughening surface is produced which brings it in a favorable state for forming the soluble oxide and after again reversing the current and the formation of soluble oxide is once commenced, the electrolytic solution goes on uninterruptedly. Comparing alkaline and acid processes for tin recovery, the latter is considered superior.—*Electrochem. and Met. Ind.*, February.

Chlorine Smelting and Electrolysis for the Treatment of Complex Sulphide Ores.—COBELDICK.—An illustrated paper describing in detail the apparatus used in the Swinburne-Ashcroft process for treating complex sulphide ores. The application to the treatment of Broken Hill ore is described in detail, and several of the apparatus used are illustrated.—*Electrochem. and Met. Ind.*, February.

Electro-Analysis.—PERKIN AND PREBBLE.—A Faraday Society paper on the electrolytic analysis of nickel and cobalt.—*Electrochem. and Met. Ind.*, February.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Zero Wattmeter Methods of Measuring Power.—CAMPBELL.—An illustrated description of two null wattmeter methods of measuring

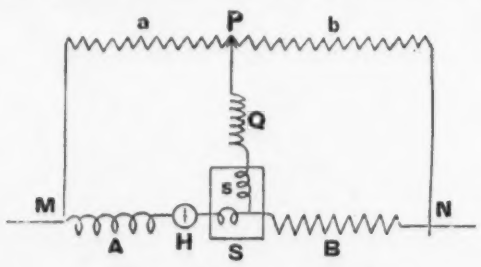


FIG. 1.—MEASURING POWER.

power. In the first method the connections are as shown in Fig. 1, in which *A* is the circuit carrying the load to be measured. In series with *A* are an ammeter, *H*, the series coil, *S*, of a wattmeter, and a known non-inductive resistance, *B*. Across the ends, *M N*, of the combination is put a non-inductive resistance with a contact slider, *P*, connected through a high resistance, *Q*, to the shunt coil, *S*, of the wattmeter. Since *B* is a known resistance, the power taken by it can be at once obtained from the ammeter reading. Now let the slider, *K*, be moved until the deflection of the wattmeter becomes zero; then the ratio of the watts in *A H S* to the watts in *B* equals the ratio of *a* to *b*, where *a* and *b* are the resistances of the parts into which the slider divides the branch resistance, *M P N*. Hence, subtracting the power lost in the ammeter and the series coil, *S*, we can at once find the power taken by *A*. Fig. 2 shows

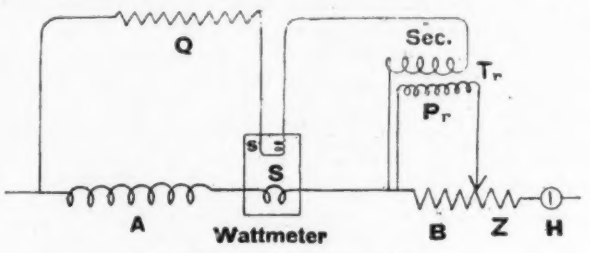


FIG. 2.—MEASURING POWER.

another (somewhat similar) way of obtaining a balance between known and unknown watts. The primary of a suitable transformer, *Tr*, is put across a variable amount, *B*, of the known resistance, *B Z*. The secondary voltage of *Tr* is connected, as shown, so as to be subtracted from the voltage on *A S*, the resultant voltage being applied to *Q S*, the shunt circuit of a wattmeter whose series circuit carries the main current. The wattmeter reading is brought to zero by adjusting the slider on *B Z*. Assuming that the primary and secondary currents in the transformer are negligibly small, that the primary and secondary voltages are in practical opposition, and that the circuit, *Qs*, is highly non-inductive, we have the ratio of the watts in *A S* to the watts in *B* equal to the ratio of secondary to primary volts in the transformer.—Lond. *Elec. Rev.*, January 27.

Measurement of Self-Inductance.—WHITEHEAD AND HILL.—In 1898 Rowland published a brief description of some twenty-six methods for the measurement and comparison of self-inductance, capacity and mutual inductance. These methods are mostly of the Wheatstone Bridge type and depend upon the use of an alternating current and an electrodynamometer. The authors have tested these methods systematically and found that, with three exceptions, the methods are of little value, their chief defect being a lack of sensibility. The best method which exists for the absolute measurement of self-inductance in terms of resistance is a zero deflection method depending upon adjusting the resistance until there is a 90° difference in phase between the currents flowing in the fixed and hanging coils of the electrodynamometer. This method is easy to apply and if proper care be exercised results should not differ from the mean by more than 0.2 per cent., while greater accuracy is undoubtedly obtainable.—*Am. Jour. of Science*, February.

Localization of High-Resistance Faults.—DAVIDSON.—A note on the localization of high-resistance faults in cable work, when such a test is to be made with a galvanometer much less sensitive than the Kelvin astatic type. A very great gain in sensitiveness can be obtained by applying the "accumulation" method to magnify the indications of imperfect balance in Murray's loop test. A condenser, *c*, in Fig. 3 replaces the usual galvanometer. The difference of

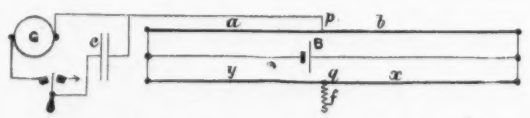


FIG. 3.—DIAGRAM OF CONNECTIONS FOR TEST.

potential between *p* and *q* when the balance is imperfect charges the condenser through the fault. Ten to twenty seconds will usually suffice to allow the condenser to take up its full charge. It is then discharged through *G* by means of a suitable switch. The ratio *a*—*b* is then altered (or a resistance is added to *x* or *y*), until a point is reached at which there is no discharge from the condenser. The following figures will give an idea of the sensitiveness of this method: $B = 3.5$ volts, $y = 3$ ohms, $x = 5$ ohms, $f = 1$ megohm, $c = 18$ microfarads, $G =$ Sullivan galvanometer balance sensitive to .1 ohm in the value of *x*. The test is most suitable for locating

high-resistance faults in short lengths of cable, and for enabling one to form an opinion whether any low insulation in a length is or is not due to a specific fault.—Lond. *Elec. Rev.*, January 20.

Meters.—GERHARDI.—A continuation of the serial on electricity meters. This installment deals with the Brush-Gutmann meter and Eclipse meters.—Lond. *Elec.*, January 27.

Armature Tests.—WEEKS.—An article, illustrated by diagrams, giving instructions for the testing of armatures in the repair shops. —*Am. Elec.*, January.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Babcock Bridging Telephone.—HENRY.—An article, with diagram, illustrating a modification of the regular bridging telephone circuit. The principal feature of the modification consists in the interposition of a condenser in the receiver circuit. When the receiver is off the hook, the voice current must pass through the condenser, but on account of the high frequency of this current the condenser increases the impedance of the circuit very little. When the receiver is placed on the hook the condenser is short-circuited and the bell is bridged across the line wires, as in the ordinary bridging instrument. If the user forgets to hang the receiver on the hook when through talking, the other bells can still be rung, which would not generally be the case with regular bridging instruments.—*Am. Elec.*, February.

Paris Telephone Service.—An article on the condition of the telephone service in Paris about which a great many complaints have been made by the public. An abstract is given of a report by Webb on the principal causes for the defective service. He recommends the reconstruction of the whole system on modern lines. This would take about two or three years and although the exact cost is not given, it would be "far less than the cost of a single battleship, and even less than the cost of an armored cruiser, and well worth the price." In Paris the total number of telephones is about 45,000, and there is a yearly increase of about 3,600 subscribers. In New York there is a telephone service serving over 150,000 telephones and increasing at the rate of 30,000 per year. It is recommended to abolish the flat rate of charging and to introduce a scientific rate tariff whereby it would be possible to reduce the minimum charge to $30 or $25 per year; this would increase the use of the telephone enormously.—Lond. *Elec.*, January 13.

Municipal Telephones.—BENNETT.—A statistical article on municipal telephones in Great Britain in 1904. During this year only one new municipal telephone station—that of Hull—was brought into operation, although all the old ones considerably extended their ramifications. There are now six municipal telephone stations with 19,188 working instruments, which represents an increase of 4,845 instruments since last year.—Lond. *Elec. Times*, January 26.

Breaks of Telegraph Lines During Storms.—MAVER.—An article on the troubles experienced during storms by breaks in overland telegraphic communication. The author discusses especially the advantages and disadvantages of underground cables, but when the extent of territory traversed by the telegraph pole lines in America is considered, the conclusion is almost inevitable that the placing of all of these wires in cables underground is impracticable, owing to the enormous expense and the reduced efficiency of operation that such action would involve. This is true to even a greater extent, perhaps, of the telephone wires. In cities, however, the situation is different and in all principal cities of America the telephone and telegraph wires are in cables underground.—*Cassier's Mag.*, February.

Automatic Block Signals.—SCOTT.—Another article in the series of automatic block signals, the present article dealing with normal clear-signal mechanism, normal clear relays and complete normal danger circuits.—*Am. Elec.*, February.

MISCELLANEOUS.

Special Steel.—SANKEY AND KENT-SMITH.—An abstract of a paper on heat treatment experiments with chrome-vanadium steel, which appears to be distinctly less sensitive to heat treatment than pure carbon steel, while the impact figure is considerably larger.—*Electrochem. and Met. Ind.*, February.

Electrical Thawing of Water Pipes.—HARDING.—An illustrated article giving some hints on electrical thawing of frozen water pipes. —*Am. Elec.*, February.

BOOK REVIEWS.

THE ELECTRICAL TRANSMISSION OF ENERGY. By A. V. Abbott, C.E. Fourth Edition. New York: D. Van Nostrand Company. 675 pages. Ten folding diagrams and sixteen full-page engravings. Price, $5.00.

The electrical transmission of energy is yearly becoming of greater industrial and national importance. This volume is intended as a text-book on the design of transmission circuits. The numerical data presented for this purpose are very complete. The introductory chapter deals with the classification of distributing systems. The next four chapters deal with overhead wires and circuits. Then follow two chapters on underground circuits. The next chapter is on railway circuits. Electrical instruments and methods of measurement then come under consideration. The remainder of the book is devoted to power transmission systems both by direct and alternating currents. The final chapter considers the costs of installations and of distributing power generally. The volume is up-to-date and contains much technical information of value to students of electric power transmission.

Closing Bulkhead Doors By Electricity.

After several years of costly experimentation with pneumatic and hydraulic systems for operating bulkhead doors and armored hatches aboard warships, both systems have been abandoned by the American Navy in favor of an electrical system, known as the "long arm" system. The first electrical installations are now in working order on the *Colorado* and *Pennsylvania*, the new 13,500-ton armored

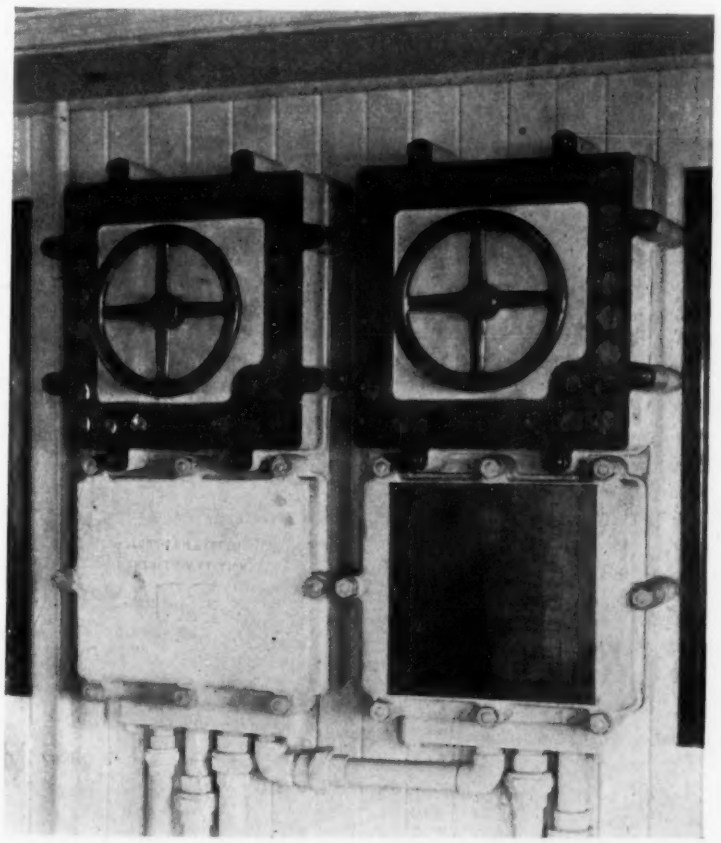


FIG. 1.—EMERGENCY STATION ON U. S. ARMORED CRUISER "COLORADO."

cruisers. Thirteen other cruisers and battleships now building will be similarly equipped.

The electrical system complies in every way with the specifications of the Navy Department providing that power doors or armored hatches "must be capable of permitting operation on the spot by power or by hand from either side of the bulkhead or deck," and "be capable of being closed by power, simultaneously from an emergency station." It is further provided that when the doors are closed and the emergency is on, any door may be opened by a man at the door to allow him to pass through in performing his duties, but after he has passed through and released the controller handle the door will again close by the emergency action.

The mechanism of the "long arm" system may be outlined as follows:

(1) An emergency station, located usually in the pilot house or some convenient place above the deck. (2) The power doors or hatch gears, supplied with three independent mechanisms, as follows:

(*a*) The switch by which a man at any door can open and close it at will from either side. (*b*) The switch, operated from the emergency station, by which the door is closed upon the approach of danger. This emergency switch, although permitting absolute control, may have its operation suspended temporarily by the hand switch just mentioned. In such a case the emergency station switch will close the door as soon as the hand controller is released. (*c*) The limit switch, by means of which the current supplying the motor which provides the power for closing and opening the doors, is cut off when the motor has closed and locked, or has encountered an obstacle to full closure. This switch has mechanical connection with the door or hatch plate and is so arranged that it will cut off the current from the motor, and thus prevent blowing out of the fuses. An interesting improvement of this part of the mechanism is one by which the switch is made to again close the circuit to the motor and thus start the door toward its grooves after an obstruction is removed, e. g., when an inflow of water washes away coal obstructing a bunker opening.

The door and hatch gear motors are direct current, reversible, iron clad, bipolar machines of light and compact construction for intermittent service. They are entirely enclosed in water-tight cases, and capable of carrying large overloads without heating or injury.

The emergency station consists of two parts, one a water-tight case containing the mechanism for controlling the circuit running to each door or hatch gear for closing the same, and the lamps to indicate the closure; the other case containing the fuse box, in which each wire is supplied with the proper fuse.

The wiring required for a complete installation of the system is

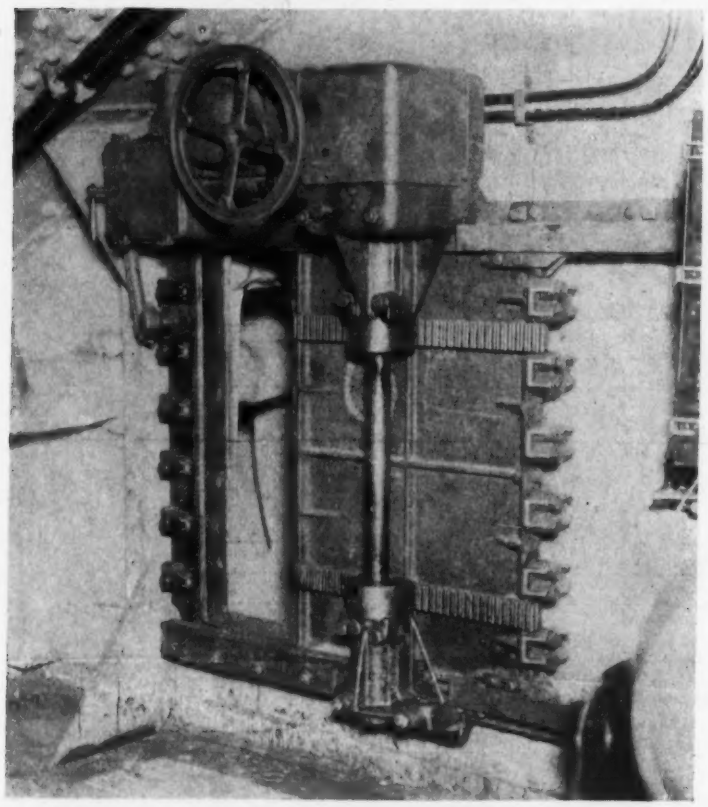


FIG. 2.—HORIZONTAL DOOR, U. S. ARMORED CRUISER "COLORADO."

very simple. It comprises one twin conductor by which the emergency station is connected with the ship's mains; one twin conductor by which the controller on each door and hatch gear is connected with the emergency station, and one twin conductor connecting the controller on each hatch gear or door with the ship's mains. Here, as in other parts of the system, great simplification has been secured by replacing pneumatic and hydraulic power by electricity. The former added another set of complicated machinery to the ship's equipment, while the electric system calls for nothing more complicated than connection with the electrical mains necessary for other purposes.

To explain the operation of the "long arm" system it is perhaps best to imagine an actual instance in which it would be called into play. Suppose that the *Colorado* is in danger of being rammed, or that her hull has been punctured by a torpedo. The officer of the deck or the one first aware of the danger will "press the button" of the emergency station, immediately releasing the gearing driven by a spring and controlled by an adequate escapement. This gearing then closes the circuit for operating the emergency switch in the controller of each door or hatch gear. It does not start all the

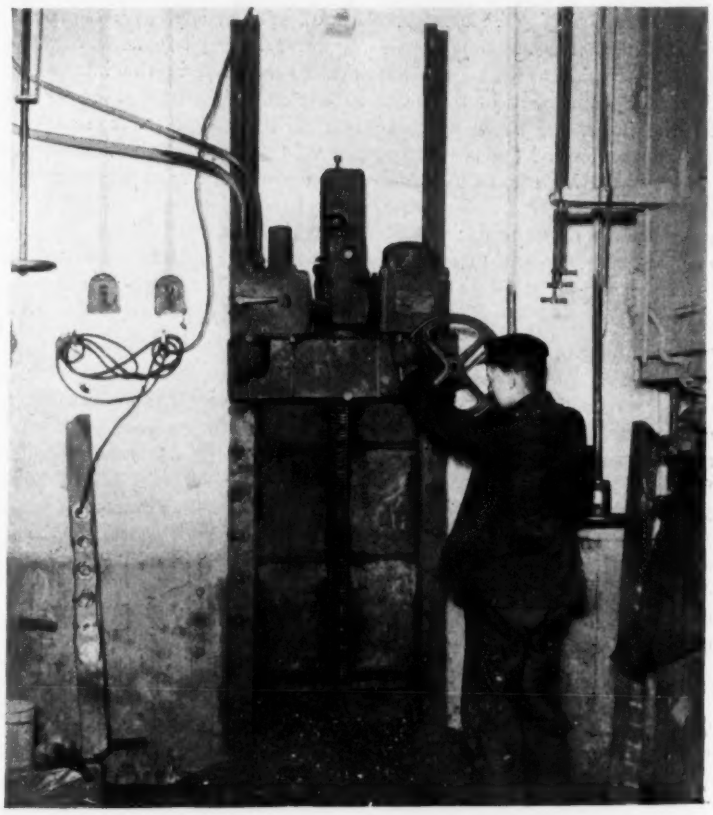


FIG. 3.—VERTICAL DOOR, U. S. ARMORED CRUISER "COLORADO."

motors at the same time, thus avoiding the necessity for a large supply of current. It starts the doors one after the other at intervals of about three seconds, so that 25 doors and hatch gears can be closed in 75 seconds from each emergency station without more than six motors being in operation at any one time.

As each door makes a complete closure it automatically completes the circuit running to the emergency station and is there connected with a small incandescent lamp, located back of each of the discs around the edge of the emergency station. Each disc is numbered to correspond to a door so that the officer in charge can tell by a glance at the station whether or not all the doors have closed. If any one door or hatch plate has not closed the fact is immediately observable, and the location of the trouble is known by reference to a diagram at hand showing the location of all the power doors and hatchways. Whether the emergency is "on" or "off" is indicated by a red light shining through one of the lower discs of the station.

National Electrical Contractors' Association.

On February 6 and 7 the Board of Directors of the National Electrical Contractors' Association, comprising twenty-six delegates from electrical contractors' associations from the various States, met at the Hotel Schenley, Pittsburg, Pa. Plans for the annual convention to be held this year and the business outlook for 1905 were discussed. Owing to the large amount of business transacted, little opportunity was afforded the delegates to visit the many industries for which Pittsburg is noted, but a party of twelve, accompanied by Mr. E. McLeary, of the McLeary Electric Company, Detroit, Mich., and president of the National Electrical Contractors' Association, spent a day in the works of the Westinghouse Electric & Manufacturing Company at the end of the convention. They

found the trip interesting and enjoyable, and only regretted that lack of time prevented a more thorough investigation of the works

DELEGATES OF NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.

of the Westinghouse interests. A group of the delegates as they appeared in the works of the Westinghouse Company is shown in the accompanying illustration, Mr. McCleary appearing as the central figure in a sitting posture.

Portable Forges.

The accompanying illustration shows a type of Sturtevant portable forge suitable for light forge work, and for use in manual training schools and mechanical laboratories of technical schools, or in railway and other repair shops. The sheet metal work is of heavy

PORTABLE FORGE.

steel plates, the running gear is heavy, strong and easy of operation. The tuyeres are made extra strong to resist the action of the fire and the fire pan is of a double metal plate with asbestos between to prevent the heat from cracking the main pan or affecting the running gear. The blower is of the well-known Sturtevant steel pressure type, has babbitted journal boxes and has been redesigned to give increased capacity.

The DeForest Wireless Telegraph Station at Chicago Opened.

The formal opening of the De Forest wireless telegraph station at Thirty-third Street and Western Avenue, Chicago, for commercial service took place Saturday afternoon, February 11. An aerogram from Mayor Harrison to Mayor Neff, of Kansas City, was the first message sent. Messages were also sent by Mayor Harrison to Mayor Wells, of St. Louis, and by State Attorney Healy to Governor Deneen, at Springfield.

While the De Forest station on the north side and the one in the Railway Exchange Building have been equipped for receiving aerograms for several months, no sending apparatus is installed in them, the first messages sent out of Chicago being those from the station at Thirty-third Street and Western Avenue.

A telegram from President White to the Chicago office of the De Forest Company announced that communications have been established between Key West, Fla., and Kansas City, which is said to be the longest transmission overland of wireless telegraphy so far accomplished.

Protective Device for Variable-Speed Motors.

The advantage of using a no-voltage protective device in the system of control of variable-speed motors is apparent. Such a feature is now being introduced by the Ward Leonard Electric Company, licensees under patents to H. Ward Leonard. The cut shows a standard field rheostat with the device mounted upon a slate base. Upon opening the line switch to stop the motor, the no-voltage coil loses its current and the magnet becomes weakened. The armature

RHEOSTAT AND NO-VOLTAGE PROTECTIVE DEVICE.

of the magnet is released and short-circuits the resistance of the field rheostat. Upon closing the switch to the motor, it is started with full field strength.

By moving the rheostat lever to the position of "all resistance out," the no-voltage armature is raised, the short-circuit is removed, and the resistance of the field rheostat can be cut in circuit to obtain the speed changes desired. Motor field rheostats of very high resistances and large taper in ampere capacity have become standard. The rheostats can always be equipped with the above protective feature if so specified.

Walrath Gas Engines.

At the National Motor Boat and Sportsmen's Show, which will be opened in Madison Square Garden, New York, next week, the Mackay Engineering Company, of New York, eastern agents of the Marinette Gas Engine Company, will exhibit the Walrath gas engine generating unit shown in the illustration on the next page. The engine, which is rated at 14 hp, will be operated by illuminating gas.

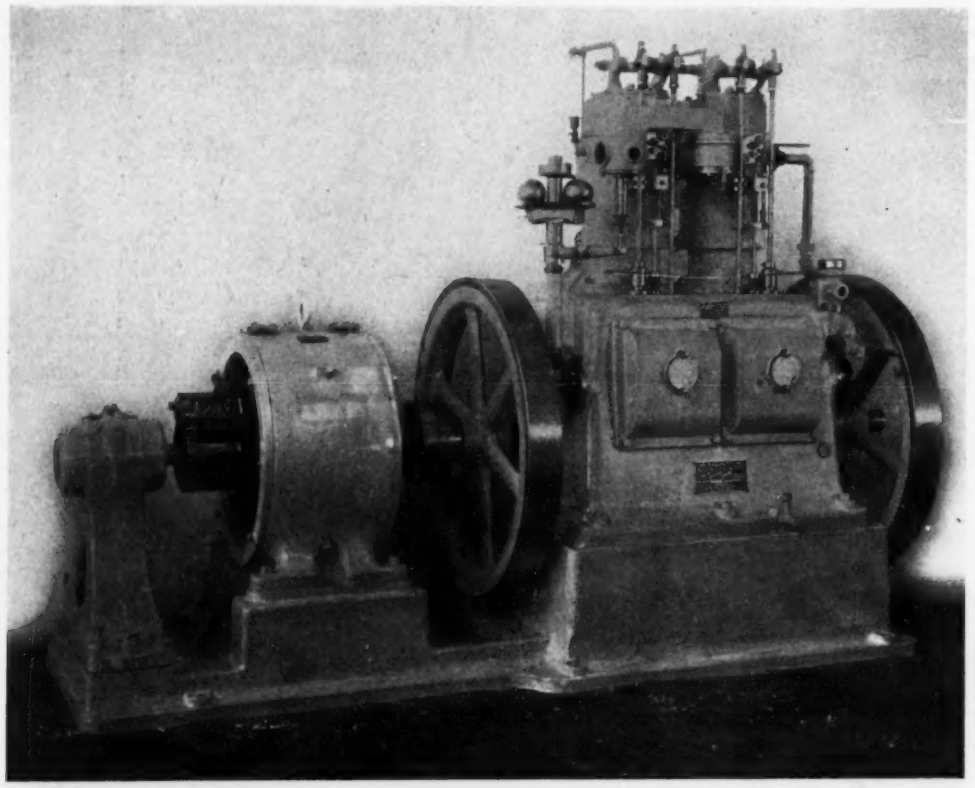
The current from the dynamo will be used for demonstrating the method of charging storage batteries for launches and for isolated lighting equipments. There will be a white marble switchboard having mounted upon it voltmeters and ammeters, circuit switches, ground detectors and dynamo switch; in fact, the exhibit will comprise a complete isolated plant operating incandescent lamps and are lamps, as well as motors.

The Walrath engine is of the vertical crank case type, but with a superior mechanical design combining strength and simplicity. The engines, which are built with one, two and three cylinders, have the advantages over the horizontal type of not requiring a massive foundation, have less vibration and in practice have proven to be more durable as to the wear on cylinders and pistons. They perform

their work on what is known as the four-cycle principle, which is employed in all successful gas engines, and is the only method which has thus far proven entirely satisfactory.

The Walrath engine is well adapted to both stationary and portable work, and owing to its close regulation of speed is especially well qualified for electric lighting, either belted or direct-connected to generator. The base is cast in one piece, is accurately bored to receive cylinder, crank and cam shaft bearings, and the bottom is planed level, assuring perfect alignment of the engine when installed. The main bearings are separate castings from the base, and are all turned up together on an arbor, and fit in a corresponding part of a circular bore made to receive them in the base, thus insuring perfect alignment of the crank shaft. They are lined with "genuine" babbit, but in special cases, when desired, phosphor-bronze is substituted.

The cylinder, or cylinders, are bolted to the top of the base and are fitted into a bore made to receive them. It is, therefore, impossible for them to get out of line. Being of the vertical type, they are free to expand without the objection of overhanging, as would be the case if placed on horizontal base. Each cylinder is cast separately, and not in one piece, as with some makes of engines. It is obvious that any damage to one beyond repair would necessitate



14-HP GAS ENGINE.

a new set of cylinders, making a very expensive repair bill, while with the Walrath method of construction all that would be necessary would be simply one new cylinder.

The valves are of the well-known poppet type, and are two in number, one for an inlet of the explosive mixture, and the other for the exhaust. They both have a positive lift and work vertically. This type of valve is the only one which experience has shown will withstand the heat to which they are subject.

On all sizes above and including 10 hp in the single-cylinder style, and 20 hp in the double-cylinder style, both valves are placed in cages, which fit into the cylinder head, as above mentioned. The joint between cages and head is ground so that to remove either valve is but the work of a few moments.

The pistons are of the open trunk type, and are made extremely long, giving an abundance of surface to bring the wear on the cylinder and piston to a minimum. This is a point not to be overlooked in an engine, as the piston being made to perform the service of a crosshead when short causes undue wear. The consequence may be a leak by the piston, which can be stopped only by expensive repairs and generally means the reboring of the cylinder and supplying new pistons and rings.

The connecting rod of the engine is a steel forging of the eye and strap type, supplied with bronze boxes at both the crank and wrist pin ends. These boxes are made so as to be easily adjusted for wear. All rods are made three strokes in length, as a short rod increases the angularity and brings more pressure to bear on the piston, thereby causing more friction and wear.

The fly-wheels are well proportioned to insure good speed regulation, and all large sizes have split hubs for convenience in putting them on the shaft to insure the most accurate fit. The engines being well balanced they do not require so extensive a fly-wheel as is employed in the construction of some makes.

The starting device is supplied on all engines above and including 20 hp. It is simple in construction and consists of an air compressor and tank. The compressor is driven from any convenient point, but generally from a small pulley placed directly on the engine shaft. It is driven only to charge the tank with air pressure of from 100 to 250 pounds, depending on the size of the engine. The pressure is kept stored in the tank until it is desired for starting.

The starting valve is simply a type of piston valve which is operated by a cam, and by means of ports making communication between the tank and engine cylinder. The air pressure is transmitted to the engine piston which moves downward. The starter valve then opens communication between the engine cylinder and the atmosphere, which causes the air to be exhausted from the cylinder after doing its work. The engine is caused to go through this series of operations until an explosion from the gases takes place. The air can then be shut off, and the engine will come up to speed with its own fuel. The operation of starting with this method is very simple and enables one man to start the largest engine with perfect ease.

The engines are adapted to run on natural, artificial, illuminating and producer gas, gasoline, distillate, kerosene and crude oil. The cost of fuel for operating a Walrath engine is stated to vary from .02 to .15 cent per hp-hour, according to the quality of fuel used and the price, which varies according to location. An absolute statement as to gas consumption without first knowing the quality of gas would, of course, be misleading.

The igniter is compact in form and free from small parts which break, work loose or cause trouble. It is secured in place by two studs, and by the removal of nuts on the same is easily accessible. The igniter can be removed without disturbing any other part of the engine, and on the multiple-cylinder type it may be removed and replaced without stopping the engine, if so desired, on account of a special construction which permits of operating any one of the cylinders independently of the others.

The governor is of the well-known Corliss fly-ball type and is positively driven by means of bevel gears. It is made to operate a piston valve, which regulates the exact amount of explosive mixture required for each impulse to maintain a steady speed under all conditions and variations of load. It absolutely controls the volume of mixture in proportion to the load it is carrying. This method of governing gives an impulse every second revolution for one cylinder, and every revolution in the two-cylinder, and every two-thirds of a revolution in three-cylinder type. So sensitive is the work of the governor that scarcely two per cent. variation can be discerned in throwing on or off full or part load. This can be equalled only by the best type of automatic steam engine, the result of which has brought the Walrath engine into the electrical field with considerable prominence.

The lubrication is performed in a very efficient and simple manner. The base forms a reservoir into which the oil is placed, so that when the engine is in operation the connecting rod at its lower stroke dips into the oil, and working rapidly splashes the oil over the working parts in the base and also the inner surface of the cylinders.

The valve-operating mechanism consists of only one shaft on all three types, driven at a speed of half the number of revolutions of the crank shaft. This is accomplished by a simple train of three spur gears which, with the gears to drive the governor, are the only gears used on the engine. The cam shaft carries the cams which operate the valves and igniter for the respective cylinder or cylinders. The cams and rollers working thereon are case-hardened and owing to the excellency of the lubrication of these parts last indefinitely.

Recent Improvement in Nernst Lamps.

To the casual observer, probably the Nernst lamp would represent the same appearance now that it did on its introduction to the public at the Buffalo Exposition in 1900. Although improvements, many of which are of vital importance, have been constantly added, the fact that the standard lamp is practically the same in its main features, as well as in external appearances, as it was almost five years ago, speaks well for the handiwork of the original designers.

The improvements introduced have been largely in the direction of perfecting the internal working parts, such as the ballast and cut-out, making them more efficient and effective and in shaping the housing to protect it from dust and insects. Aside from these improvements, mostly of a mechanical nature, and which have been embodied in the standard lamps for sometime past, a brief description of a number of recent developments may not be without interest.

FIG. 1.—THREE-GLOWER LAMPS WITH CONVERTER COIL.

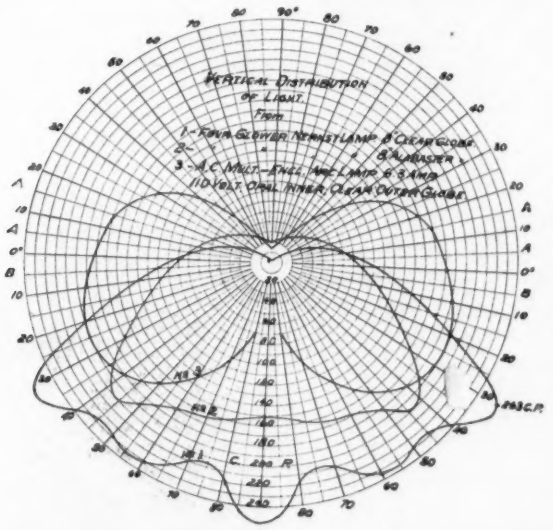

VERTICAL DISTRIBUTION OF LIGHT.
From
1 - FOUR GLOWER NERNST LAMP & CLEAR GLOBE
2- " " & ALABASTER "
3 - A.C. MULTI-PHASE ARC LAMP 6.6 AMP.
110 VOLT. OPAL INNER, CLEAR OUTER GLOBE

FIG. 2.—DISTRIBUTION CURVE OF FOUR-GLOWER LAMP.

FIG. 3.—NERNST LAMP HOLDER.

The demand for multiple-glower lamps for 110-volt circuits, coming mostly from a class of small consumers, has been efficiently met with the "converter coil," which, being used in connection with the standard 220-volt lamps, adapts the latter for use on 110-volt, alternating-current circuits. This finds its greatest use in small installations, where it is desirable to use a few multiple-glower lamps without altering the existing 110-volt circuit. This device, which is similar in its electrical design to the ordinary balance coil now on the market, is mounted above the lamp on the ceiling, and presents a neat appearance, similar to that of an ordinary canopy, as shown in Fig. 1.

For interior lighting, the standard six-glower Nernst lamp is distinctly higher in illuminating power than the 6.6-amp., alternating-current, constant-potential arc, while the latter is somewhat brighter than the three-glower Nernst lamp. The demand for a Nernst lamp which would replace this standard arc lamp has led to the development of the four-glower lamp, having the same external appearance as the six-glower lamp. This has already proven to be a very popular lamp for store lighting. The design of the holder is such as to give the light distribution a very flattened shape, as may be seen from the curves shown in Fig. 2. For this reason the illumination furnished by this lamp is more uniform than that obtained from the other types.

For ornamental purposes, both in outdoor and indoor work, it is frequently desirable to use fancy newel posts which terminate at the top in a globe of light. It is therefore obvious that to gain this effect with the Nernst lamp it must be inverted so that the globe is uppermost and the lamp body concealed in the upper portion of the post. Such a design has recently been perfected, and any of the standard units are now available for this purpose.

With a view toward assisting the customer in gaining maximum economy in the operation of his Nernst system, a special switch attachment has recently been brought out, which is intended for use in connection with the four and six-glower lamps. At times when only a portion of the total light is required, it becomes possible through the use of this attachment to throw half the total number of glowers out of operation and thus effect a material saving in the current bill. This will be of particular value to the small consumer using three and four lamps, where it is not practicable so to arrange the lamps on separate circuits that alternate lamps may be thrown off, without seriously affecting the general distribution of the light. With the exception of a third binding terminal post on the top, the external appearance of this lamp does not differ from that of the standard type. It is stated to be the only lamp on the market in which the light can be lowered without inserting resistance and where a lessening of the amount of illumination is accompanied by a proportionate reduction of current consumption.

Fig. 3 shows the standard single-glower holder equipped with a "Thermo" heater cut-out which consists simply of a special plug for connecting the heater lead wire to the heater terminal post and thence to the central contact prong. This plug is composed of a metal having a low melting point, so that when the glower breaks and the heater has been in operation about five minutes, sufficient heat is generated to fuse the plug and disconnect the heater, thus saving it from further deterioration. Experience shows that this simple device has affected quite a saving in maintenance cost, as ordinarily the failure of the glower means also injury to the heater, owing to the fact that the user neglects to turn out the lamp after the glower fails.

The duties of the trimmer have been made easier by the substitution of a spring globe holder and the chain suspension for the three thumb-screw method of fastening, and a material saving in time and glassware is expected through this agency. The arrangement is similar to that used on arc lamps.

The generally recognized superiority of the Nernst light for the illumination of art galleries has led to the development of a special reflector to be used in connection with lamps of the multiple glower type. This reflector, illustrated in Fig. 5, is of light, rigid construction and is fastened to, and supported by, the lamp in the same manner as the standard shade. The planes and angles of the reflector are so designed that when installed as indicated in Fig. 4 the direct rays falling on the exhibit which occupies the wall space are reinforced where necessary by reflected light and the resultant illumination is practically uniform from top to bottom of the exhibit.

Fig. 5 is a cut of one of the standard units used for lighting the exhibit of Fine Arts at the St. Louis Exposition and a modification

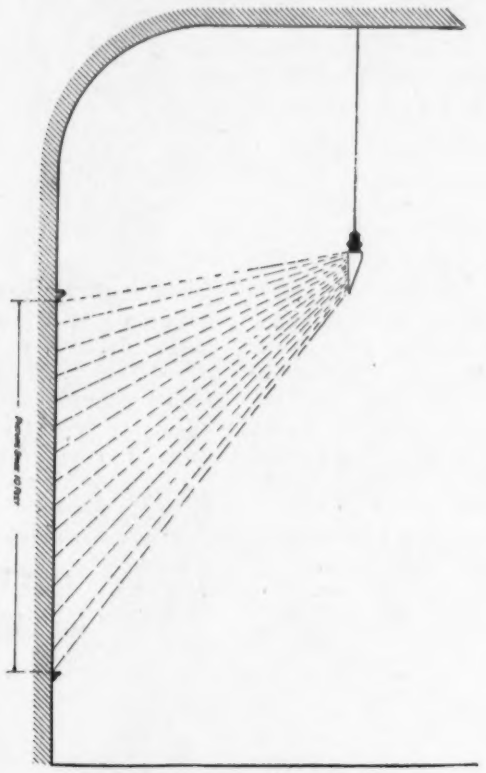


FIG. 4.—DIAGRAM OF REFLECTORS.

of the type shown will be used extensively in the new Albright Art Gallery at Buffalo.

To meet the requirements of residence or office installations where light is desired immediately upon turning the switch, a combination lamp has been designed having incandescent lamps in parallel with

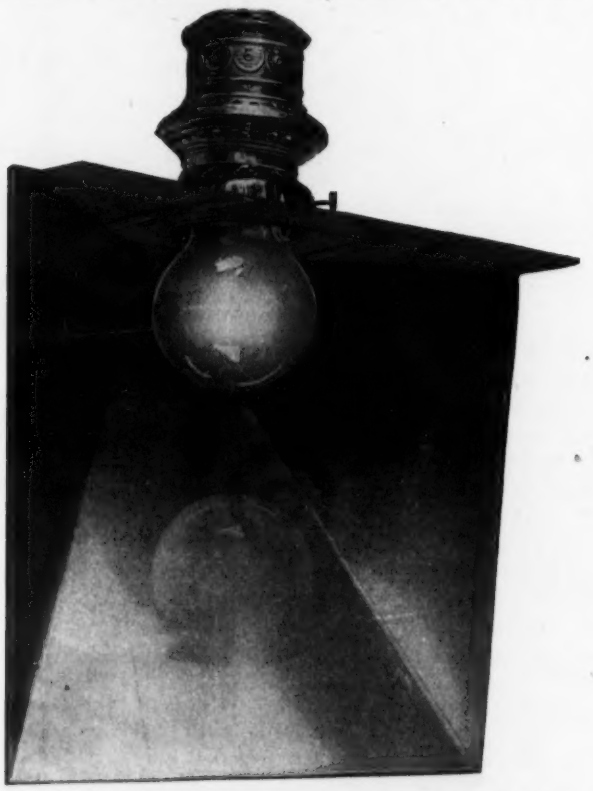


FIG. 5.—THREE-GLOWER LAMP WITH ART GALLERY REFLECTOR.

the heaters of the Nernst lamp. The two incandescent lamps are operated in series and a cut-out breaks the incandescent circuit at the same time that the heaters are cut out. The design is quite simple and any of the standard lamps can be changed over to this type at a very small expenditure. The fixtures used are of the ordinary standard pattern, two 110-volt Sawyer-Man incandescent lamps being used.

Motor-Starting Panels with Circuit-Breakers.

One of the recent changes in electrical practice is the general adoption of switchboard panels containing the control apparatus for individual motors. Before their introduction controlling rheostats, line switches and protective devices have been mounted in the most convenient place available, often with apparent disregard of fire risk or the protection of the operator. The use of a panel insures the proper mounting of the apparatus and provides a neat and convenient arrangement, with means for mounting in any desired location.

FIG. I.—STARTING PANEL WITH FIELD RHEOSTAT.

The accompanying illustrations show two of the styles of starting panels for direct-current motors designed by the Westinghouse Electric & Manufacturing Company, and employing a two-pole, Type D circuit-breaker instead of the customary switch and fuses. The circuit-breaker is especially adapted for this use, as one pole is connected in each leg of the circuit, the poles closing independently but tripping simultaneously. In closing the circuit, if there is an overload upon the line, the pole first closed opens immediately upon closing the second, thus instantly interrupting the circuit and preventing damage. It is strongly built, with

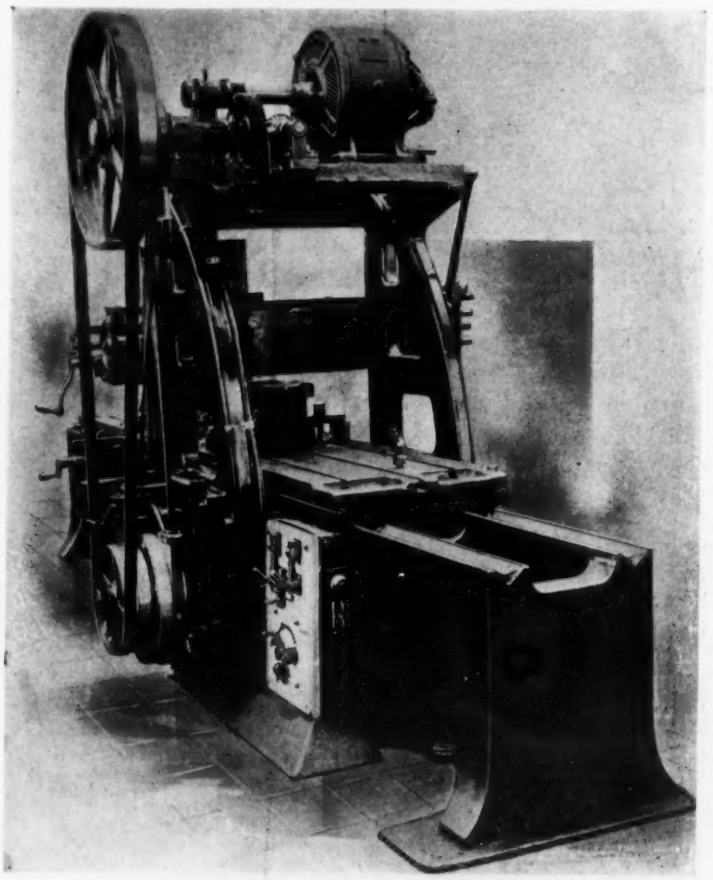


FIG. 2.—PLANER OPERATED BY 5-HP MOTOR, SHOWING STARTING PANEL.

few parts, none of which are small. It is provided with hinged, movable contacts of the brush type, and with carbon tips to which the current is shunted when the circuit is broken, preventing sparking at the contacts. The circuit is fully broken at the contacts before there is any movement of the carbon tips. There are no springs except the strong strip of spring steel which carries the carbons, the blow of the armature tending to open the breaker and not simply

to release the moving parts. The device is reliable in its action, and is adjustable for different loads.

These panels with circuit-breakers are furnished in two styles, those with field rheostats for motors requiring shunt field regulation for varying speed, and those without field rheostats, for constant-speed motors. A starting rheostat with minimum voltage release is generally employed with Westinghouse motors. As soon as the supply circuit is interrupted, the rheostat automatically opens the circuit, making it impossible to damage the motor by restoring full line potential to the circuit when the motor is at rest. The field rheostat ordinarily provided with Westinghouse motors is mechanically strong, and will stand continuously the field current of the machine with which it is used, in any position of the handle. No combustible material is used in its construction.

The slab is of slate, with a dull-black marine finish, harmonizing with the black oxide finish of the apparatus. When ordered, brackets are supplied for wall mounting, or gas pipe frames of rigid construction (such as are used upon the Westinghouse Type 7-B panels), are provided for mounting upon the floor. Capacities range from ⅛ to 50 hp, 110 volts and from ⅛ to 100 hp, 220 volts. Sizes of panels vary from 11 x 23 x 1 in. to 20 x 48 x 1¼ in., according to the space required for the apparatus. In capacities to 10 hp, 110 volts and 13½ hp, 220 volts, panels without field rheostats are made with front connections, if desired.

These panels are designed in strict accordance with government specifications and answer all requirements of the most rigid inspection. They are especially adapted for separate machine tool drive, being so designed as to permit mounting directly on the frame of the machine tool driven by the motor, as shown in Fig. 2, which represents a 32 x 32 x 10 planer in the shops of the Union Pacific Railroad, Omaha, Neb.

Sangamo Direct-Current Watt-Hour Meter.

The latest type of meter of the Sangamo Electric Company, of Springfield, Ill., which is illustrated herewith, is of the mercury contact type. The rotating element is a heavy copper disc immersed in mercury and enclosed in a box of specially formed insulating material which is said to be both hard and durable. In the walls of this chamber are embedded copper contact ears shown in Figs. 2 and 3, and connected outside by knurled adjusting nuts to flexible

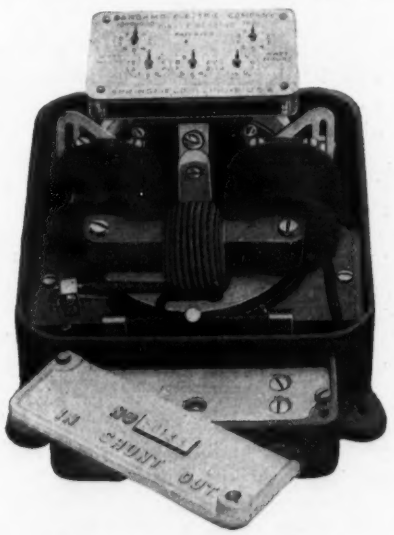
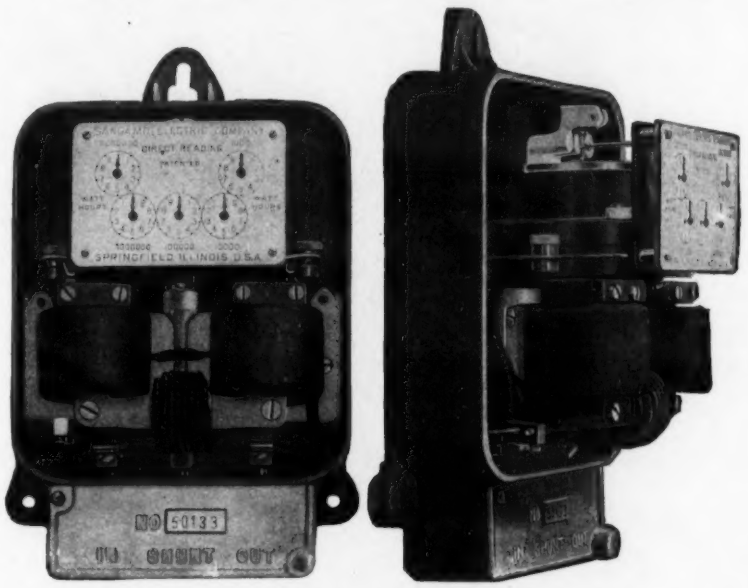


FIG. 1.—WATT-HOUR METER.

cables carrying the main current. Two powerful magnetic fields cause rotation of the disc. The fields are due to two soft iron poles embedded in the lower half of the disc chamber wall, and energized by the series and shunt coils. These same fields are also used as damping magnets to govern the speed of the meter, so that no permanent magnets are used.

To overcome in a measure the buoyant effect of the mercury on the disc, a counterweight is attached to the disc shaft in an upper part of the insulating casing. This weight being a trifle less than the buoyant effect of the mercury, permits of a slight thrust against the jewel in the upper bearing of the meter. This bearing carries a flat jewel, and has a fine screw adjustment to give the disc just the contact pressure desired. When the adjustment is complete, the bearing is held in position by a small screw.

Owing to the strong field and small air-gaps, external magnetism has no effect on the meter. An iron return plate above the disc and the iron back of the meter also act as an effective shield. The meter is sealed in the case after being tested, and need not be removed, as the mercury is shipped in the disc box and the spilling of it is prevented by the design of the opening through which the disc shaft passes to the outer upper bearing. A pocket is provided,



FIGS. 2 AND 3.—WATT-HOUR METER.

into which the mercury flows when the meter is turned over; when the meter is placed upright and in position, the mercury returns to its proper place.

The meter is adjusted by sliding the connecting nuts back and forth on the copper disc box ears, thus altering the distribution of current through two paths in the disc having different torque effects. The light load adjustment is very simple and may be easily made. A high resistance rod, shown below the shunt magnet in Fig. 1, has a sliding connector on it which is in contact with the ingoing shunt wire. By altering the position of this wire along the rod, the small current passing to the shunt coils is divided between two paths, one through the disc and back to the connector through the right end of the rod, and the other directly from the in post through the left end of the rod. That portion of the current passing through the disc tends to produce some rotative effect, and this effect is varied by moving the sliding connector from the left to right of the resistance rod.

The meter is 9 in. high, 5½ in. wide and projects 4¾ in. when installed. The case may be of aluminum or glass, the meter with the former covering weighing 10 pounds. For 110 and 220-volt meters all resistances are placed in the case; for 500-volt meters the resistance tubes are placed in a small perforated cast-iron box, which may be located near the meter. All meters up to 40 kw capacity read directly in watt-hours; the larger sizes require a multiplier.

Electrical Revolving Display Case.

The accompanying illustrations show a novel type of mechanism which will serve to increase the popularity of electricity as an agent in effective and economical advertising. The "Beaver" display machine is a new mechanical device designed for the purpose of displaying and handling large quantities of merchandise within a small space at the least possible cost. The principal novel and advantageous feature of the equipment embodies the means for giving life to the mechanism.

The smallest type of machine, although occupying only three feet of floor space, contains 1,440 square inches of tray or shelf space, the trays revolving constantly while being supported rigidly in a horizontal position. The device is given life by means of a small motor placed in the base of the machine. The motor develops

but a small fraction of a horse-power, while the amount of energy for the lamps can be varied at will to suit the owner of the case. Although the total cost of operating and lighting will not exceed three cents per hour, it never fails to attract at least 75 per cent. of the passing public and fully 100 per cent. of the shoppers to its contents, no matter what may be the line of goods exhibited.

As seen in the views presented herewith, the electric motor is

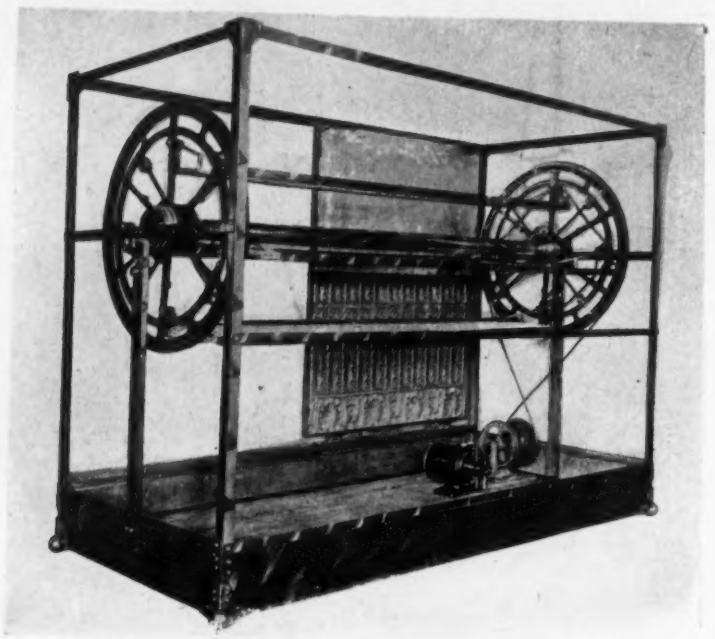


FIG. 1.—ROOM DISPLAY CASE.

belted through appropriate reduction gears to a wheel supported at one end of the revolving mechanism. Fastened rigidly to the supporting frame is a small wheel resembling the rear sprocket of a chain-driven bicycle. Over this sprocket passes a bicycle chain which engages with from 4 to 18 sprockets mechanically connected to the corresponding number of display trays in such a manner that in whatsoever position the revolving mechanism may be placed, the trays will remain rigidly horizontal. All bearings are equipped with case-hardened steel balls, to reduce wear and friction to a minimum.

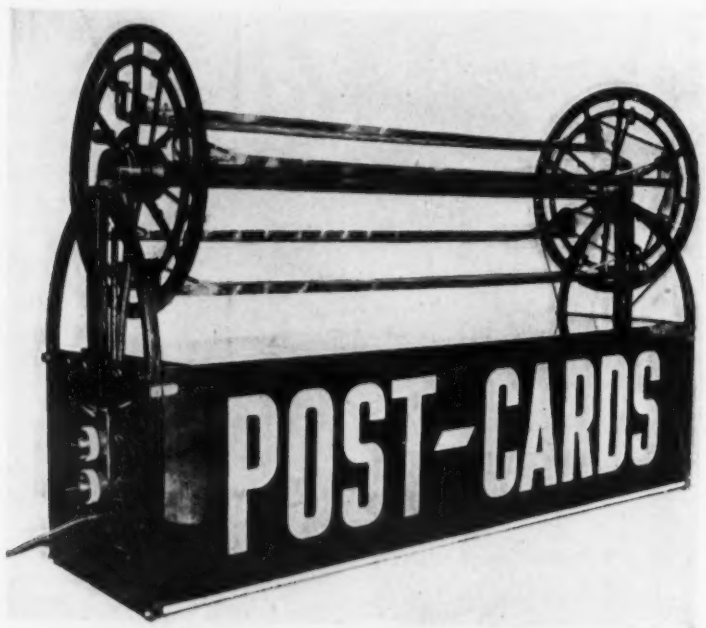


FIG. 2.—WINDOW DISPLAY CASE.

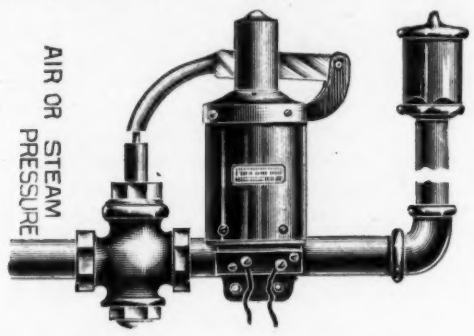
Small electric lamps supplied with current through slip rings are disposed around the end wheels in a manner to illuminate the goods to best advantage.

In the front of the lower part of the case can be placed a display sign, as shown in one of the figures, having transparent letters, through which varied colored light may be sent. To this end, in the lower half, is rigidly supported a row of plain incandescent lamps, the light from which is caused to pass through a revolving thin sheet of celluloid colored in any desired way.

The display machine can be easily moved from one position to another, and is adapted to any and all lines of small merchandise. This interesting advertising device is being placed on the market by the Thompson-Bonney Co., 14 Church Street, New York.

Electrically Operated Whistle.

By adding electrical operation, new uses have been developed for the ordinary steam whistle. In a type being placed upon the market by the Electrical Appliance Company, Cincinnati, Ohio, the whistle may be connected up to any number of simple push-buttons or keys and operated either by direct or alternating current. A recently developed use for this apparatus is in connection with



ELECTRICALLY-OPERATED WHISTLE.

private branch telephone exchanges. In the case of men whose duties require their presence in many places remote from the office, the operator by touching a button can sound a whistle that he would hear. Any number of different signals can be arranged to reach as many different men. For example, the button may be pressed three times, thus giving three blasts of the whistle; the one for whom this signal is intended can then go to the nearest telephone, call the private exchange operator, and connect with the calling party without delay.

Big Electric Crane Concerns to Consolidate.

Negotiations are now under way and arrangements are expected to be completed within the next few days relating to the combination of two of the largest engineering and manufacturing concerns which made specialties among other machinery of electric cranes. The firms in the deal are the Brown Hoisting Machinery Company, Incorporated, of Cleveland, and the Wellman-Seaver-Morgan Company, of the same city.

The Brown Company is one of the biggest builders of ore-handling plants, shipbuilding cranes, etc., in the world. The company was founded in 1880. Its capital fully paid is $2,000,000. Mr. F. Brown is president, Mr. Alex. E. Brown vice-president and general manager, and Mr. Harvey H. Brown treasurer. The Eastern offices are at 26 Cortlandt Street, New York, of which Mr. W. A. Stadelman is manager.

The Wellman-Seaver-Morgan Company operates large engineering works at Cleveland, while at its Webster, Camp & Lane division's plant, at Akron, Ohio, various machinery is manufactured on an extensive scale. The company builds equipment for every operation, from taking the ore out of the mine to turning it into completed product. The president of the company is Mr. S. T. Wellman. Mr. J. W. Seaver is chairman of the board of directors. The first vice-president is Mr. S. H. Pitkin. Mr. G. H. Hulett is also one of the vice-presidents. The general manager is Mr. C. H. Wellman, while Mr. A. D. Hadfield is the secretary and treasurer of the company. The New York offices of the concern are at 42 Broadway, of which Mr. George B. Damon is the manager.

The Brown Company's ore-handling equipment is very extensively utilized throughout the country, one of the most recent installations having been made at the Pittsburg & Conneaut Dock Company (controlled by the United States Steel Corporation) docks at Conneaut, Ohio, where a record was lately made in the unloading of ore from the big lake freighter *Wolvin*. This plant is electrically equipped

throughout. The Brown machinery is also used largely in foreign government plants, notably in the German and Austrian shiploading yards and by the Swedish Government railways. Vickers Sons & Maxim, Limited, Robert Stephenson & Son, Harland & Wolff and other big shipbuilding plants in the United Kingdom also use Brown cranes, etc. The famous Krupp steel works at Essen, Germany, are installed with the same American equipment and several Russian and Belgian industrial works have been purchasers on several occasions.

The Wellman-Seaver-Morgan Company's ore-handling plants are also largely installed on this side. Its equipment, as well as the Brown Company's, was used in the construction of the Chicago Drainage Canal. The Hulett ore unloaders, named after the inventor, one of the vice-presidents of the company, are also used at Conneaut and at the Lackawanna Steel Company's plant. The company has also taken a number of British contracts for the remodernizing of big blast furnace plants on the other side.

The greatest secrecy is being pursued by both parties as to the deal, and no official information can be obtained. The ELECTRICAL WORLD AND ENGINEER, however is informed on very excellent authority that unless something very unexpected happens the final papers will be signed inside of the next week or ten days, and that a new company will be formed for the purpose of operating the two concerns with a capital in the neighborhood of $10,000,000.

Automatic Time-Switch.

The Crescent Company, of Chicago, is placing on the market an automatic time-switch for controlling show windows or sign circuits

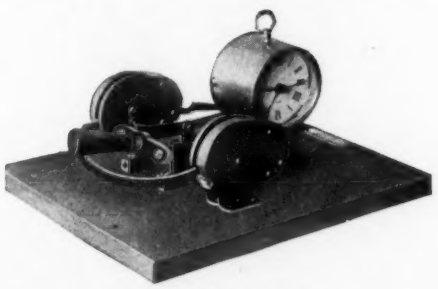


FIG. 1.—TIME-SWITCH.

of from 25 to 75 amp. It consists essentially of a polished slate base on which is mounted a standard knife switch, either 2 or 3-

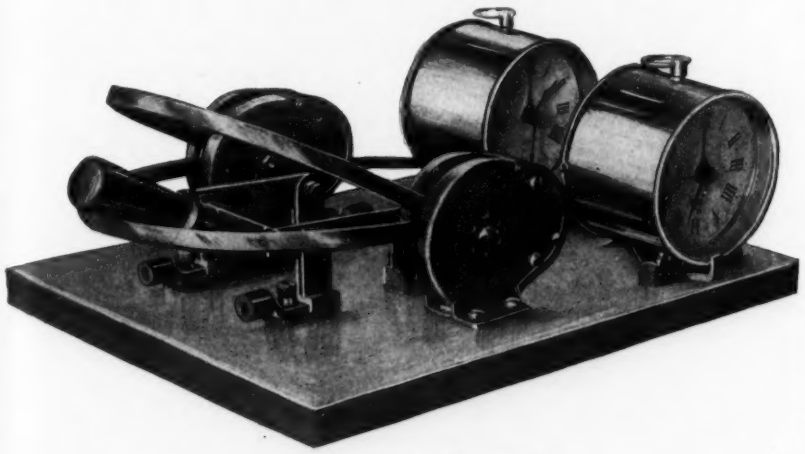


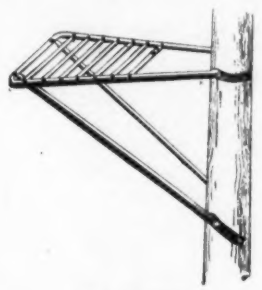
FIG. 2.—TIME-SWITCH.

pole, as the case may be, which is controlled by either one or two Parker alarm clocks.

The switch is connected in the circuit and is used as an automatic service switch for the show window or signs. It is simply necessary to set the clock at the specified time, which is done the same as in the case of any ordinary alarm clock. At the time set the clock will trip the heavy spring which actuates the knife switch and cut out the entire circuit. One type turns lights off only. Another of similar design is made with two clocks, and automatically turns on the lights and turns them off again, at any predetermined times. With this device the merchant can close his store before it is dark, or before the evening crowds are on the street knowing that at exactly the time when he considers it will pay, the lights will be turned on, and turned off again at the hour he considers it will no longer pay.

Security Pole Seat.

The pole seat shown in the accompanying illustration is made by the F. Bissell Co., of Cleveland, Ohio, and is stated to have been received with much favor by central station and street railway companies. In appearance it is, of course, much superior to wooden seats, or seats with projecting iron slats. As will be seen, the seat



POLE SEAT.

frame is all in one piece, being bent at the corners. The seats are tested to 1,000 pounds, but will stand a weight of a ton. The cross slats are machine-riveted to the rim, leaving a smooth exterior. The pole braces are of angle iron, thus again lightening the structure. The extreme lightness of this seat is a particular advantage where cable poles carry a heavy load.

Ball-Bearings for Electric Motors.

A novel type of ball-bearing suitable for use on electric motors is shown in the accompanying illustration. In distinction to the more usual bearing equipment in which adjacent balls come in contact directly or through counter rolling surfaces, the new type of construction is such that there are interposed between the balls,

BALL BEARINGS FOR MOTORS.

properly proportioned springs within each of which is placed a piece of felt for the purpose of retaining a lubricant. If in consequence of the bend of the shaft there is a tendency for the outer ring to get out of true with the inner ring, the variation of speed of the balls is counterbalanced by the action of the springs, so that the balls will not be damaged. Easy access to the balls is provided for the purpose of inspection.

These bearings have been applied not only to small motors but to machines as large as 200 hp, including electric railway motors. They have been supplied by the European manufacturer, the German Small Arms Factory, of Berlin, to the following firms of international reputation: The Siemens-Schuckert Co., the Electrical Industries Company, Allgemeine Elektricitäts Company, Brown, Boveri & Cie, Lohmeyer, etc. The rights for their manufacture and sale in this country have been acquired by the Hess-Bright Manufacturing Company, Fifteenth and Chestnut Streets, Philadelphia, Pa.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The West, Northwest and Far West report improvement in spring jobbing, nothwithstanding the continued heavy winter weather. In the South, the weather conditions have checked development. Cold weather, snow and sleet have interfered with river transportation and with the telegraph service throughout the entire South. Industry continues active, and in the iron trade statistics show that production and consumption are the heaviest on record. Complaints are still made of collections, due probably to the effect of the weather in dulling retail distribution, etc. The labor situation is, on the whole, favorable, but the perennial unrest in the New York building trade is again manifesting itself, with possibilities of future trouble. The general undertone is still one of undiminished confidence in a large trade when winter's grip is definitely broken and mild weather arrives.. Reports of railway gross earnings for January indicate a gain of 6 per cent. over the corresponding month last year. This is regarded as extremely satisfactory, considering the weather conditions which prevailed during the period. The great development of industry at the South in iron and steel, lumber, naval stores and cotton manufacturing prevents universal dullness, and that section is really in better shape to stand the present cotton condition than ever before in its history. The output of iron in January was the largest ever recorded, but, nothwithstanding this, stocks decreased. The outlook is for February to do relatively better, weather permitting. In finished products developments promise to be interesting. Specifications are coming in freely, and the finishing mills are reported behind on orders. Small receipts; strengthening of the holding tendency on the part of Southern producers and good consumptive reports at home and abroad encouraged short covering in cotton. On this movement spots have advanced a full cent from the low point touched at the close of last year. The government ginning report, showing 12,700,000 bales ginned, seems to have been regarded as a bull feature when probably the exact reverse is true, because hundreds of ginners are said not to have made any reports. Selling to secure profits toward the close of the week lost some of the recent advance. There is a decrease in the number of business failures for the week ending February 9, as reported by *Bradstreet's*, the aggregate being 207, as compared with 239 the week previous. During the corresponding week of last year the number was 202.

GREAT NORTHERN POWER COMPANY.—Details have already been given in these columns as to the proposed development by the Great Northern Power Company. The plans of the company provide for beginning work at once on the St. Louis River, near Duluth. The electrical manufacturing companies have had their representatives on the ground, and the type of generator to be used has been decided upon. The style of dam to be built was another subject that took much thought. The matter of most importance was the designing of the waterwheels, for a head of 365 feet. Mr. J. T. Fanning, of Minneapolis, one of the best hydraulic engineers of the country, has been a consulting engineer with Messrs. C. C. and F. A. Cokefair from the start. W. A. Breckinridge, superintendent of the Niagara Falls plant, has been retained as a consulting engineer for two or three years past, as has also F. O. Blackwell, formerly chief engineer of the General Electric Company. The company has recently increased its capitalization to $8,000,000.

IMPORTING SCIENTIFIC INSTRUMENTS.—In a decision written by General Appraiser Eugene G. Hay, the Board of United States General Appraisers recently overruled a protest by Lunham & Moore, of New York, against the assessment of duty on a copper cylinder and fittings, the property of Carl Snyder, a scientific writer. Free entry was claimed for it as a professional implement or an instrument used in the laboratory of a scientific writer. The testimony showed that Mr. Snyder arrived in this country on November 15, 1901, and the articles in dispute on April 14, 1903. Mr. Hay ruled that in order to secure free entry such articles must accompany the owner on his arrival.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has just sold to the La Belle Iron Works at Steubenville, Ohio, a direct-current engine-type generator, to be rated at 1,000 kw., the voltage to be 250. The contract includes also a switchboard of blue Vermont marble. The Westinghouse apparatus already installed in this plant includes alternating and direct-current generators with a total rated capacity of 1,250 kw, a 300-kw rotary converter and over 200 motors, not including those used on the cranes, ranging in size from 1 to 200 hp. About two-thirds of these are Westinghouse Type C alternating-current motors.

MORE WORLD'S FAIR MACHINERY SOLD.—A 400-kw Crocker-Wheeler generator which was utilized to furnish current in the Intramural Railway plant at the Louisiana Purchase Exposition, has just been sold through the Chicago engineering firm of Hoover & Mason, for use in the power plant at the Minnesota iron mines of Jones & Laughlin, of Pittsburg, Pa. The machine is of standard railway type, 550-volt, compound wound and runs at a speed of 150 r.p.m. It was direct-connected to a 600-hp Harrisburg engine of tandem compound type. The engine was not sold, however.

EQUIPMENT FOR MESTA POWER PLANT.—The Mesta Machine Company, of West Homestead, Pa., one of the largest engine and other machinery builders in the Pittsburg district, is to install a new power plant. The equipment will consist of two 400-kw generators, which will be direct-connected to Corliss engines of the company's own build and two generators of 200-kw capacity each, which are to be arranged for direct coupling to gas engines. A number of motors will also be put in. The coal handling machinery will be electrically operated.

LIGHTING PLANT FOR PHILIPPINES.—A contract has been placed for the electric lighting equipment to be installed in the United States naval station buildings at Cavite, Philippine Islands. The engineering and contracting firm of Mackenzie, Quarrier & Ferguson, 114 Liberty Street, New York City, has secured an order for a 150-hp Harrisburg-Fleming side crank engine for direct connection to a three-wire generator 125 and 250 volts, 250 r.p.m. of General Electric build.

PLANT FOR QUINTARD IRON WORKS.—The contract has been let for the generating equipment to go in the Quintard Iron Works, East Twelfth Street, New York City. The Crocker-Wheeler Company, Mr. F. B. De Gress, manager, secured the work. The generators will consist of two 60-kw, 240-volt engine type machines and one 30-kw capacity. At the time of writing, the contract for the engines was not closed. Bates & Neilson, of 42 Broadway, are the consulting engineers.

MEXICAN POWER, TELEGRAPH AND TELEPHONE PROJECT.—Two Mexican capitalists, Messrs. Quijero and Rivero, have secured a concession from the authorities for the building of a big water power plant on the Atoyac River, State of Pueblo, and the construction of a telegraph and telephone system in that part of the world. The concession permits of the entry free of import duty of the material, machinery, etc.

AUTOMATIC TELEPHONE DEAL.—N. D. Neill, president of the American Machine Telephone Company, who is at present at Brantford, Ont., announces that the company has sold its American rights to the Lorimer Telephone Company, a Chicago organization, capitalized at $10,000,000. The company retains its Canadian rights and is seeking a competitive franchise in Brantford.

PLANT FOR ELECTRICAL EXCHANGE.—A new lighting plant is to be put in the Electrical Exchange Building, 136 Liberty Street, New York City. The equipment will comprise one 75-hp and one 40-hp Buffalo horizontal center crank engine arranged for direct connection to Westinghouse generators of 50-kw and 25-kw capacity, respectively. The system will be a three-wire one.

WATER WHEEL GOVERNORS.—Among the recent sales made by the Sturgess Governor Engineering Company is one closed with Z. & W. M. Crane, Dalton, Mass. Two Sturgess governors are used on a pair of Dayton 21-inch wheels. The plant operates at a 150-ft. head. One of the interesting features is a 48-inch pipe line running for 7,000 ft.

CHICAGO AUTOMATIC TELEPHONES.—It is announced that the Chicago Subway Company has discontinued installing automatic telephones. As the number at present installed is sufficient to conform with the terms of the company's franchise, it is said no more will be put in until the tunnel is completed.

CHANGES AT DANVILLE.—The Danville Street Railway & Light Company is about to put in a 1,500-hp engine and a 60-cycle alternator to supply all of the A. C. electric lighting in Danville. Most of the transformers have been changed from 130 to 60-cycle types already.

PLANT FOR COPPER MINE.—The Utah Copper Company, of Bingham, has awarded contracts for electric haulage and general equipment of its properties to the General Electric Company.

SOME CROCKER-WHEELER ORDERS.—The Crocker-Wheeler Company, through its New York offices, reports receipt of a number of orders for generators and motors. Snyder & Black, New York City, have ordered fifteen motor equipments for their new printing plant. The machines will be utilized for driving printing presses. They are to be 230-volt motors, ranging in capacity from 1-hp to 7½-hp. The United Dressed Beef Company has requisitioned for eight motors, 115-volt machines for driving 36-in Wing disc fans. The Crocker-Wheeler Company recently secured a contract for two 150-kw belt type generators for the same company. J. B. & J. M. Cornell, of Cold Springs, N. Y., have ordered three special motors of 75-kw, 35-kw and 25-kw capacity, respectively. These motors will be field weakening, 230-volt type. They are to be used for driving machine tools. The Isbell-Porter Company, builders of refrigerating machinery, of Newark, N. J., has ordered a number of motors—500-volt machines—for operating electric cranes in its plant. The Wilcox & White Company, of Meriden, Conn., has ordered several motors, varying from 15-hp to 25-hp in capacity for its factory equipment.

SOME C & C ORDERS.—The C & C Electric Company, 143 Liberty Street, reports recent receipt of a number of orders for generators, motors, etc., for installation in office buildings and manufacturing plants, etc., in various cities of the Eastern States. Two 75-kw., 250-volt, 275 r.p.m. generators, arranged for direct connection to Ball & Wood engines have been ordered for light and power purposes in the North River Insurance Company's building, New York City. A motor dynamo combination of 350-ampere capacity, and with a voltage variation of from 45 to 70, has been ordered by the Chester (Pa.) Steel Castings Company. The E. W. Bliss Company, of Adams Street, Brooklyn, has contracted with the C & C people for a 75-hp slow speed, 220-volt motor to be used for driving an air compressor. The Hildreth Varnish Company, of 71 North Twelfth Street, Brooklyn, is to be shipped a fair sized belted dynamo of 250 volts. A number of 5-hp and 70-hp C & C standard motors have also been ordered for installation in the Hildreth plant.

CANADIAN GENERAL ELECTRIC COMPANY.—Because the cost of power is one-third greater in Montreal than it is in the city of Peterboro, is the reason given for the Canadian General Electric Company deciding to shut down its plant in Montreal and removing it to the latter city. It is further pointed out that lower factory costs followed the very low cost of power, and the company looked to effect an economy of fully 20 per cent. in these costs as compared with Montreal. The Montreal plant will be shut down about April 1 next.

EQUIPMENT FOR S. O. & C. PLANT.—The S. O. & C. Company, of Ansonia, Conn., which concern is one of the allied interests of the United Shoe Machinery Company, of Boston, has placed a contract with Mackenzie, Quarrier & Ferguson, 114 Liberty Street, for a 75-hp Harrisburg-Fleming side crank engine for direct connection to a 50-kw., 125-volt, 275 r.p.m. Crocker-Wheeler generator. This outfit is intended for light and power purposes. Further equipment, etc., is expected to be purchased very shortly.

EQUIPMENT FOR N. J. ZINC PLANT.—The New Jersey Zinc Company, of Jersey City, has placed a contract for a 100-kw, 125-volt Crocker-Wheeler generator and seven motors of same build, and of 15 hp capacity each. The motors are to be utilized for driving blowers, the contract for which was secured by the Niagara Radiator Company, of 39-41 Cortlandt Street. The equipment is for installation in the Franklin Junction, N. J., plant.

OAXACA HYDRO-ELECTRIC PROJECT.—Mexican advices state that Mr. Charles A. Hamilton, of Oaxaca, Mexico, is primarily interested in a concession which is being sought from the Mexican Government for the construction of a good-sized hydro-electric plant to be located near the city of Ejulta, State of Jalisco. It is proposed to light that city and to supply power for general use in the vicinity.

GENERAL CONTRACT FOR ALTMAN STORE.—Mr. Marc Eidlitz, of 489 Fifth Avenue, has been awarded the general contract for the big Altman department store to be built on Fifth Avenue, between Thirty-fourth and Thirty-fifth Streets, and in which a good-sized electrical plant will be installed.

EQUIPMENT FOR LOS ANGELES.—The Edison Electric Company of Los Angeles, Cal., has ordered a 1500-kw engine type alternator of Brown-Boveri type to be arranged for direct connection to a McIntosh-Seymour engine. The generator will be built by the Crocker-Wheeler Company.

FANS FOR JAPAN.—Mr. Francis A. Cundill, of 93-96 Wall Street, representative of the British firm of L. J. Healing & Co., of Yokohama, has received a requisition calling for the shipment of a large lot of desk fans to Japan.

PLANT FOR FIFTH AVENUE APARTMENT.—A light and power plant will be installed in a large apartment house, which the Presbyterian church people are to build at Eleventh Street and Fifth Avenue. Renwick, Aspinall & Tricker are to be the architects.

LIGHTING PLANT FOR TEMASCALTEPEC.—The municipal authorities of Temascaltepec, a mining centre located in Mexico, have contracted with Francisco Segura & Hermano, of Mexico City, for the installation of an up-to-date lighting plant.

LAMPS FOR CUBA.—Mr. George F. Tremain, of 135 Broadway, has secured a contract for several thousand incandescent lamps to be exported to Cuba.

Financial Intelligence.

THE WEEK IN WALL STREET.—While manipulation played a major part in the movements of stock prices, firmness prevailed and the absorption of investment securities continued, being on a scale commensurate with the heavy accumulations of capital throughout the country. The market ignored the passage of the railroad rate bill in the House, and was influenced mainly by minor but favorable incidents, affecting Union Pacific, Atchison, the local tractions and other groups of stocks. The bond market continued very firm, with a large demand, coming principally from institutions. There were few movements of importance among the industrial stocks, and United States Steel preferred, after holding well when it sold ex-dividend, tended to ease off a little apparently from neglect, but regained ground on Friday. The decided strength of Metropolitan Street Railway and in Metropolitan Securities stock attracted much attention. These demonstrations were accompanied by renewed reports that a unification of the New York Traction properties, through an acquisition of the Metropolitan system by the Interborough Company, is among the near possibilities. Metropolitan Street Railway ranged from 117¾ to 123⅜, closing at 122¼, which is a net gain of 4¾ points. The sales of shares aggregated 238,700. Interborough Rapid Transit made another sensational rise in the curb market, with an extreme gain of 20 points, one-third of which was afterward lost, however. The closing quotation was 219, a net gain of 10 points, the range of prices being 208, the lowest and 225 the highest. Brooklyn Rapid Transit was not affected by the activity in New York transportation stocks, and closed at 62⅜, a net gain of 1 point. The electric securities were quiet and little business was done in them. Allis-Chalmers common made a net gain of 1 point and preferred 3, the closing prices being 16½ and 65, respectively. General Electric closed at 187, an advance of ¼ point. Western Union Telegraph made a net gain of ⅜, closing at 93¼, and American Telephone and Telegraph lost 2¼ points, the last quotation being 143¾. Following are the closing quotations of February 13:

NEW YORK

	Feb. 7	Feb. 14		Feb. 7	Feb. 14
Allis-Chalmers Co.	15⅝	16½	Electric Vehicle	15	15
Allis-Chalmers Co. pfd.	64	62	Electric Vehicle pfd.	23¼	23⅛
American Tel. & Cable.	94	94	General Electric.	186¼	186½
American Tel. & Tel.	144	141	Hudson River Tel.	..	..
American Dist. Tel	25	30	Interborough Rap. Tran.	217⅛	218
Brooklyn Rapid Transit.	62⅛	62¼	Metropolitan St. Ry.	120¼	122⅛
Commercial Cable	..	..	N. Y. & N. J Tel.	..	..
Electric Boat	38	39	Marconi Tel.	..	..
Electric Boat pfd.	76	79	Western Union Tel.	92⅜	92⅝
Electric Lead Reduction	¼	¼	Westinghouse com	179	178½
			Westinghouse pfd	188	185

BOSTON

	Feb. 7	Feb. 14		Feb. 7	Feb. 14
American Tel. & Tel.	144⅛	142⅞	Western Tel. & Tel. pfd.	102¼	102
Cumberland Telephone.	120	120	Mexican Telephone.	1	1
Edison Elec. Illum.	251¾	250	New England Telephone.	*137½	136
General Electric	186¼	185½	Mass. Elec. Ry.	15	13¾
Western Tel. & Tel.	20⅞	20⅝	Mass. Elec Ry. pfd.	59¼	55

PHILADELPHIA

	F-b. 7	Feb. 14		Feb. 7	Feb. 14
American Railways.	50⅛	50	Phila. Traction.	100¼	100⅜
Elec. Storage Battery.	78⅛	78	Phila. Electric.	10	10⅛
Elec. Storage Battery pfd.	..	..	Phila. Rapid Trans.	25⅝	28⅛
Elec. Co. of America	10⅝	10⅛			

CHICAGO

	Feb. 7	Feb. 14		Feb. 7	Feb. 14
Central Union Tel.	..	..	National Carbon pfd.	113	111
Chicago Edison.	155½	157½	Metropolitan Elev. com.	21¼	20½
Chicago City Ry.	198	..	Union Traction.	13	11⅛
Chicago Tel. Co.	141	141	Union Traction pfd.	..	48½
National Carbon.	42	42½			

*Asked.

VALLEY COUNTIES POWER COMPANY.—A San Francisco firm is offering for sale a block of the first mortgage, 5 per cent. sinking fund bonds of the Valley Counties Power Company, at $101.50, yielding 4.90 per cent. per annum. The bonded indebtedness of the Valley Counties Power Company is $2,500,000, is due on May 1, 1930, and payment is also guaranteed by the Bay Counties Power Company, which owns all the stock. A sinking fund is provided by annual payments out of earnings. The engineer's report states that the property has water powers capable of development sufficient to add at least 20,000 hp, and probably largely in excess of 50,000 hp, to the present generating capacity of 15,600 hp.

SAN FRANCISCO LIGHTING.—The California Gas & Electric Corporation shows earnings for December of $436,013, as compared with $277,943 in 1903. The ten months for 1904 showed $3,533,573, as compared with $2,338,930 in 1903.

TRACTION WORK IN NEW YORK.—The first quarter's report of the Interborough Rapid Transit Company since the opening of the Subway, shows that contrary to expectation the elevated division shows an increase in gross earnings for the quarter ended December 31, 1904, over the corresponding quarter in 1903. The increase is about $7,000. The net income, however, is not so great as the previous year for the reason that the operating expenses and fixed charges were greater in 1904 than they were in 1903. For the six months the net income of the entire system (including the Subway), is $850,880; for the six months ended December 31, 1903, it was $965,279. The report of the system for the quarter ended December 31, shows:

	1904.	1903.
Gross earnings	$4,472,855	$3,657,709
Operating expenses	1,888,087	1,396,395
Net earnings	2,584,768	2,261,314
Other income	96,013	85,598
Fixed charges	2,241,212	1,596,579
Net income	439,569	750,335
Operating cost, per cent.	42.21	38.17

The division of the opening figures of the system, overhead and Subway, for the December quarter are:

	Manh'n Ry. Div., quarter ended Dec. 31, 1904.	Subway Div., Oct. 27 to Dec. 31, 1904.
Gross earnings	$3,660,764	$812,090
Operating expenses	1,428,833	459,254
Net earnings	$2,231,931	$352,836
Other income	81,500	14,513
Gross income	$2,313,432	$367,349
Fixed charges	2,066,057	175,155
Net income	$247,375	$192,194
Operating per cent.	39.03	56.55

Comparing the returns with those for the same quarter in 1903, when the Subway was not in operation, it appears that the increase in passengers amounted to 16,245,582, a daily average for ninety days of 180,506. The increase in passengers for the six months was 22,254,348, showing that the total increase for the quarter ending September 30, when the Subway was not in operation was only 6,008,766. During the December quarter therefore the increase was at the rate of 266 per cent. over the rate of increase for the September quarter. This increase in passengers carried represents a normal augmentation of 10 per cent., namely, about 7,280,000 passengers, so that the additional increase of about 9,000,000 must have been drawn from the surface systems at the average rate of 100,000 a day.

AMERICAN DISTRICT TELEGRAPH.—The annual report of the American District Telegraph Company of New Jersey for the year ending December 31, representing the results of the consolidation, is as follows:

	(12 mos.) 1904.	(13 mos.) 1903.	Changes.
Gross	$2,389,971	$2,259,573	Inc. $130,398
Expenses	1,691,176	1,721,108	Dec. 29,932
Net	$689,795	$538,465	Inc. $160,330
Dividends	389,959	427,127	Dec. 37,168
Surplus	$308,836	$111,358	Inc. $197,498
Previous surplus	111,338	.....	.....
Total surplus	$420,174	$111,338	.....
Appro. for construc. and new equip.	364,303	.....	.....
Balance	$55,871	.....	.....

The balance sheet, as of date, December 31, 1904, shows:

Assets:	
Plants, fran. stocks, patents, etc.	$9,740,385
Capital account	364,303
Supplies	44,438
Burglar alarm equipment factory	15,779
Cash due	117,231
Sundry accounts receivable	63,268
Total	$10,345,404
Liabilities:	
Capital stock issued	$9,740,385
Profit and loss	420,173
Sundry accounts payable	184,846
Total	$10,345,404

AMERICAN BELL TELEPHONE.—Advices from Boston say: Notwithstanding the ease of the money market, the American Telephone Company is not concerning itself with new capital requirements at this time, as there is no desire to prematurely load the company with interest or dividend charges. The $20,000,000 5 per cent. notes which were issued last spring, do not mature until May, 1907, so that it is too early to consider any financing looking toward the payment of these notes. Notwithstanding increased interest charges last year, the American Telephone Company will show a surplus after dividends as the result of its 1904 operations, no less than was shown for 1903, when the balance after interest and 7½ per cent. dividends, was $2,445,000. In the middle west, or in the territory, for instance, of the Central Union Company—Illinois, Indiana and Ohio—the competition of the independent companies has been very severe, but the Bell companies are slowly but surely wearing down this competition and meeting it with improved methods, and a conservative financial policy.

TAXATION OF NIAGARA POWER.—Following Canadian example, Assemblyman Wade, of Jamestown, has presented a bill in the lower house of the New York Legislature for the taxation of corporations using the water of the Niagara River for power purposes. Mr. Wade is chairman of the Committee on Taxation and Retrenchment. The bill provides that each corporation using the water for power purposes shall pay up to and including in the aggregate 20,000 horse-power, $1.50 a horse-power; for every horse-power above 20,000 and up to 30,000, $1 per horse-power; for every horse-power above 30,000 and up to 40,000, 75 cents, and for every horse-power above 40,000, 50 cents. It is supposed that the revenue might reach $750,000 to $1,000,000 annually.

BELL TELEPHONE ABSORBING.—It is stated from Cincinnati that the Cincinnati & Suburban Bell Telephone Company is negotiating with between fifteen and twenty independent telephone companies in cities in Ohio, Indiana and Kentucky, with a view to absorbing the same. For several weeks experts employed by the local company have been examining these various plants and systems, and thus far have reported on about half of the companies involved in the gigantic absorption scheme. The work is being pushed, in order to have all reports ready by February 15, which is the date of the annual meeting of the local telephone company. It is certain that out of the total number of companies under consideration a good part of them will be taken over.

WESTERN ELECTRIC YEAR.—The annual meeting of the stockholders of the Western Electric was held February 3. A total of 8,240 shares were represented in person and 103,558 by proxy, making 111,789 shares represented out of a total of 120,000 outstanding. Charles S. Holt, James W. Johnson and C. G. Dubois retired as directors, and were succeeded by C. W. Amory, Thomas Sherwin and Charles Williams Jr. The other directors were re-elected. The report for the fiscal year ended November 30, showed that the total sales for the year were $34,454,000, as compared with $30,256,000, a gain of 7.2 per cent.

PHILADELPHIA RAPID TRANSIT.—The board of directors of the Philadelphia Rapid Transit Company sold on Monday to Drexel & Company an issue of $10,000,000 4 per cent. bonds at par. They are 50-year first mortgage bonds upon the property of the Market Street Electric Railroad Company, and are guaranteed by the Philadelphia Rapid Transit Company. There will be turned over to the company for immediate use for the building of the elevated and underground system $5,000,000 and the remainder as required from year to year for the extension of the lines.

SAN FRANCISCO GAS & ELECTRIC COMPANY.—The financial statement of the San Francisco Gas & Electric Company for the year ended December 31, 1904, is as follows: Total receipts, $4,396,859.08; expenses, $3,331,425.33; net profit, $1,065,433.75; Dividends, $792,421.68; surplus, $273,012.07. The capital stock outstanding amounts to $15,794,284.36; bonds outstanding, $9,813,000, and the net amount of floating debt is $816,934.19.

SCHENECTADY TROLLEYS.—A pool representing Delaware & Hudson and New York Central has bought the Schenectady Railway from General Electric. It is said that the price included two million dollars in cash and the assumption of the bonded debt. The Schenectady system is one of the "banner" trolley networks of the whole country, splendidly built and admirably managed.

CHICAGO CITY RAILWAY.—The Chicago syndicate, comprising Marshall Field, P. A. Valentine and John J. Mitchell, who have control of the Chicago City Railway, have turned over to J. P. Morgan & Co., who are financing the enterprise, a check for $28,000,000, representing 140,000 shares purchased.

BUFFALO BELL TELEPHONE.—The Bell Telephone Company, of Buffalo, reports as follows for the year ending December 31:

	1904.	1903.	1902.
Gross	$1,246,285	$1,103,380	$979,787
Expenses	918,367	761,765	682,571
Net	$327,918	$341,615	$297,216

AMERICAN CARBON & BATTERY COMPANY.—An application for an increase in its capital stock from $50,000 to $150,000 was filed February 2, by the American Carbon & Battery Company, St. Louis, Mo. The assets of the company, as shown by the documents, are $162,958.48, and the liabilities $35,359.15.

DIVIDENDS.—The California Gas & Electric Corporation, of San Francisco, has declared its regular monthly dividend No. 10 of 15 cents per share, payable February 15. The board of directors of the American Railways Company has declared a dividend of 1½ per cent. on the capital stock, payable March 15.

General News of the Week

The Telephone.

SILOAM SPRINGS, ARK.—The Siloam Springs Telephone Company, which recently succeeded to the business conducted by Stahl & Alfrey, expects to build 20 miles of toll lines.

LITTLE ROCK, ARK.—The Caddo Cove Telephone Company, of Ghent and Johnson, Ark., has been chartered with a capital stock of $20,000. The incorporators are J. Johnson, J. L. Thomas, T. J. Hughes and G. A. Dreggers.

REDLANDS, CAL.—The Southwestern Home Telephone Company, of Redlands, has filed articles of incorporation. The company will build a line from Redlands, Beaumont, Banning, San Jacinto and Hemet, and thence along the line of the Southern Pacific to Yuma, Arizona. The work of constructing this line is already under way and when completed will be the only telephone line from California to connect with the Arizona lines. The incorporators of the new company are K. C. Wells A. Gregory, C. H. Bigelow, J. F. Dostal, R. J. Dunn, J. W. Lamb and J. L. Shirley.

HARTFORD, CONN.—A resolution was offered in the General Assembly, Feb. 7, empowering the Southern New England Telephone Company of New Haven, of which Morris F. Tyler is president, to increase its capital stock from $5,000,000 to $10,000,000. President Tyler said that the company was making provision for future development of the telephone business and planning for extensions in the near future.

CARLYLE, ILL.—A rural telephone company will operate a line on the Carlyle road. The line will be connected with the local office of the Bell Telephone Company. The officers are: President, Peter Schultz; treasurer, Jacob Gundlach; secretary, Julius Knobelock.

INDIANAPOLIS, IND.—Thos. Taggart, proprietor of the General Hotel, announces that he will install a telephone in each of the 276 rooms in his hostelry.

LAKETON, IND.—The Disko & Laketon Telephone Company, which was incorporated in November last, expects to install an exchange at Roann, Ind., for local and toll service.

TIPTON, IND.—The Sandbank Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $1000. J. M. Hoover, Henry C. Haskett, George A. Dickey and others are the incorporators.

SEYMOUR, IND.—The Farmers' Union Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $2000. Jno. M. Lewis, W. H. Boman, John Q. Foster and others are the incorporators.

WABASH, IND.—Because of increasing demands and increasing business requiring extensions and improvements, the Home Telephone Company has increased its capital stock from $20,000 to $50,000. R. F. Blount is president and W. S. Stitt, secretary.

INDIANAPOLIS, IND.—M. D. Atwater, local manager of the Central Union Telephone Company, has been promoted to district superintendent. He will be succeeded by W. R. Hurst, former superintendent of the Cleveland Telephone Company.

SPARTA, IND.—The Sparta & Hogan Mutual Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $700. The company will establish an exchange at Sparta and do a telephone business throughout Dearborn County. O. E. Canfield, Frank Hawness, of Sparta, and S. J. Huston and Margaret Croyer, of Hogan, are the incorporators.

FORT DODGE, IA.—By a recent fire in the building, partly occupied by its exchange, the Iowa Telephone Company sustained considerable damage to its switchboard, largely through the effect of water.

NEVADA, MO.—The Long Distance Telephone Company, of Kansas City, has filed a mortgage here for $1,500,000 to the Commonwealth Trust Company. The company is building a line from Joplin to Kansas City.

JEFFERSON CITY, MO.—A bill permitting municipal authorities to regulate all telephone charges in the cities of the State was passed in the Senate Feb. 2. The measure came up from Kansas City, where the charter of the Bell Telephone Company has expired. It will not affect charges in St. Louis, as an amendment providing that existing charters shall not be affected has been consented to. Whenever the present charter of the Bell Company expires the city may regulate charges.

PICKERELL, NEB.—Fifteen of the farmers, patrons of the Home Telephone Company, have organized a farmers' exchange.

FAIRBURY, NEB.—An interest in the Fairbury Telephone Company has been bought by Messrs. C. W. Bartlet & Son. This company has 500 telephones in service and 8 lines reaching into adjacent towns and farming districts.

LEIGH, NEB.—At the annual meeting of the Leigh Independent Telephone Company the following officers were elected for the ensuing year: Fred Moeller, president; Dr. J. H. Lowery, vice-president; J. H. Pieper, secretary; Fred Dusenbroch, treasurer, and H. P. Bulman, manager. The financial report showed the company to be in a prosperous condition.

YORK, NEB.—Stockholders of the York County Independent Telephone Company are receiving semi-annual dividend checks of 5 per cent., making 10 per cent. for the year, and have the privilege of buying more stock which is being issued for building extensions in the lines and bettering the service. A toll line to connect with the independent system at Lincoln is being constructed. The company is in a very prosperous condition and has 2000 subscribers.

OMAHA, NEB.—The Nebraska (Bell) Telephone Company is making extensive additions to its switchboard equipment and is stringing many new cable lines to take care of the greatly increased demand for service in Omaha, from 1000 to 1500 new subscribers having been secured through the recent active canvass and reduction of rates offered to forestall the efforts of independent companies which sought a franchise. Though the exchange building has but recently been enlarged to double its former size and a new central energy system established, supposed to be adequate for a number of years' growth, additional facilities are felt to be needed and plans are being prepared for a branch exchange to be located in the residence district at 33d and Harny Streets. The new branch building is to be two stories, of brick and stone, 25 by 100 feet, and to have a switchboard capacity for 5000 telephones. The new rate reduction, which applies to residence telephones only, is in the shape of a rebate or discount of $1 per month, conditioned on the payment of bills at the company's office by the 10th of the month. By this reduction the schedule will be $3 for individual residence telephone, $2.50 for two-party and $2 for four-party service. The other rates are not affected.

WESTON, OHIO.—The stockholders of the Crescent Telephone Company, at their recent annual election at Weston, elected the following officers: John Bamer, president; Sumner Cottingham, vice-president; Azor Thurston, secretary; W. D. Mudge, treasurer. The company started five years ago with 35 subscribers, and now has 1000.

CANTON, OHIO.—The annual meeting of the Stark County Telephone Company was held in Canton recently. No change in the officers or directors was made. The common stock in the treasury amounted to $190,000 was converted into 6 per cent. preferred, which will be sold to take care of development instead of increasing the present bond issue of $325,000 outstanding.

CLEVELAND, OHIO.—The Cleveland Telephone Company announces another reduction in rates for residence telephones. The new rate for unlimited, two-party line service is $42 per year, the former rate being $48. With a discount allowed if a bill is paid within the first month of each quarter the rate is reduced to $36 per year. Reductions in other classes of service are contemplated.

LIMA, OHIO.—At the annual meeting of the stockholders of the Lima Telephone & Telegraph Company the former board of directors was re-elected. The board of directors re-elected D. J. Cable, president; W. H. Duffield, treasurer, and Geo. H. Metheany, secretary and manager. It was decided to sell $5000 preferred stock of the company for extensions to the plant which the growth of the city now demands.

WEST RICHFIELD, OHIO.—The West Richfield Telephone Company, of Summit County, has been incorporated with $10,000 capital. The incorporators are Edwin L. Carter, Jas. B. Stauffer, J. B. Kennedy, M. L. Newton and Allen A. Prickett. The company will build an exchange in West Richfield and will extend lines all over the township and over the townships adjoining in Medina and Cuyahoga counties. It will also connect its lines with independent lines, giving a full long distance service.

CLEVELAND, OHIO.—The profit sharing plan, introduced in the management of the Cuyahoga Telephone Company, in July, 1903, by President F. S. Dickson, it is stated, will probably be indefinitely continued by the management. The distribution of the profits among the various employes for the last half of the past year will be made during the present month and will amount to 6½ per cent. on their wages. The amount to be distributed for the last half of the year is the largest fund ever paid out among the employes and will amount to $7022.19. The company has distributed more than $16,000 among its employes during the 18 months it has had the plan in operation.

ZANESVILLE, OHIO.—At the annual meeting of the Zanesville Telephone & Telegraph Company the new board of directors organized by electing F. S. Dickson, president; S. M. Granger, vice-president; J. B. Rhodes, secretary and general manager; R. W. Judd, treasurer. The directors and officers are the same as those who served last year. In the near future a large number of two and four-party selective services will be installed. The material for this work is nearly ready and operations will be begun as soon as possible. Preparations are also being made to increase the service in the Dresden and Roseville exchanges.

YORK, PA.—Extensive improvements will take place in the near future in the telephone service in this city, which put it on a par with that in the larger cities. The York Telephone will do away with the old drop switchboard, which will be replaced by the central energy system. About 100 telephones in the York exchange are being operated successfully by the new system. As yet the company has installed the system only on single lines. Within the next few weeks, it will begin the installation of the system on party lines.

CLARKESVILLE, TEX.—The Home Telephone Company expects to build some farm lines. Mr. John B. King is president of the company and Mr. B. F. Fitz Gerald, secretary.

BAIRD, TEX.—The Home Telephone & Electric Company has filed articles of incorporation, with a capital stock of $25,000. The incorporators are I. N. Jackson, S. L. Driskell, T. S. Powell, S. H. Ramsey, Bertie Richardson, all of Baird; and J. M. Esles, of Clyde, Tex.

SPOKANE, WASH.—The trades council, at a meeting recently held here endorsed the application of the Independent Telephone Company for the establishment of a system here. Representative of the council are examining the independent system at Los Angeles, Cal.

Electric Light and Power.

GOODWATER, ALA.—Arthur Salmon, of Dadeville, has secured a franchise for an electric light plant in Goodwater.

ENGLAND, ARK.—The Martin-Reynolds Electric Company, of Little Rock, has secured the contract to install an electric light plant at England for J. B. Gray, for about $5000.

PRESCOTT, ARIZ.—A big electric power and transmission plant is to be established at Parker's Butte, about 75 miles from Prescott, by the Verde Water & Power Company. It is proposed to develop about 20,000 horsepower which will be transmitted to Prescott and other towns of the territory. It is also planned to supply many mines with power.

NAUGATUCK, CONN.—The Connecticut Railway & Lighting Company has installed transformers in the New High School Building for the electric lighting and motor power.

SANTA BARBARA, CAL.—The Merchants' Mutual Light & Power Company has been incorporated, with a capital of $25,000, by John T. Johnston, C. H. Frink and J. H. Burson.

SAN JOSE, CAL.—The National Park Electric Power Company, of San Jose, has been incorporated with a capital of $250,000, by J. J. Inman, M. E. Page, W. H. Baugh and others, all of San Jose.

FRESNO, CAL.—The San Joaquin Power Company has decided to begin at once the construction of another power plant near the Crane Valley reservoir, with a capacity of 3500 horse-power. Wm. G. Kerckhoff, Los Angeles, is president.

LOS ANGELES, CAL.—It is stated that an independent electric light and power company is about to be formed here by the Broadway Improvement Association. F. W. Blanchard, Maj. J. H. Norton, S. M. Schneider and others are interested.

SAN FRANCISCO, CAL.—Articles of incorporation of the San Mateo Power Company have been filed. The company will manufacture gas and electricity for heat, light and power; capital $1,000,000. Directors: Walter J. McLean, Henry Bostwick, Leo H. Susman and others.

SAN FRANCISCO, CAL.—It is reported that the Southern Pacific Railroad Company is installing an electric lighting plant at Carlin, Nev., from which will be lighted switch and signal lamps and station houses at a number of small stations in that region. The wires will be strung upon poles formerly used by the company for telegraph wires. It is also said that the company will erect additional electric lighting stations at intervals along the Ogden route for use in connection with the extensions of the block system of signals.

SAN FRANCISCO, CAL.—The Walker River Electrical Company, which has been incorporated under the laws of the State of Nevada with a capitalization of $20,000 has for its purposes the construction and operation of a telephone line from Wellington to Carson, Nev., where connection may be had with the Pacific States Telephone & Telegraph Company's long distance lines. It is also intended to construct a telephone line from Wellington to Yerrington via Nordyke. The directors of the new corporation are Frank Simpson, Wm. Reading, Arthur Colin, Charles Day and John O'Bannion, all of Smith's Valley.

COLORADO SPRINGS, COL.—At the annual meeting of the Colorado Springs Electric Company, held Jan. 31, officers were elected as follows: President, W. A. Otis; first vice-president, George R. Buckman, both of Colorado Springs; second vice-president, S. R. Bertron, of New York City; secretary and treasurer, Irving W. Bonbright, Colorado Springs; assistant secretaries and treasurers, F. W. Stehr, of Colorado Springs, and Murray Dodge, of New York City; general manager, George B. Tripp, of Colorado Springs.

WASHINGTON, D. C.—Albert and J. M. Anderson, of Boston, Mass., have secured the contract for a 29-panel switchboard for the Washington Navy Yard for $13,530.

WASHINGTON, D. C.—The Empire Light & Power Company has been chartered, capital stock, $500,000. Incorporators: D. S. Fletcher, N. A. Smith and K. M. Fletcher.

WASHINGTON, D. C.—Bids will be received Feb. 21 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing at the navy yards at Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C., and Norfolk, Va., a quantity of arc lamps, electrical supplies, cable, battery cells, electric equipments for ammunition hoists, brass wire, copper rivets, iron pipe, pipe fittings, magnet wire, cable, incandescent lamps, mica, electric blowers, electrical supplies and other material. H. T. B. Harris, Paymaster-General, U. S. N.

SAVANNAH, GA.—Bids will be received March 3 by Jas. Knox Taylor, supervising architect, Treasury Department, Washington, D. C., for installing conduit and electric wiring system in U. S. Marine Hospital here.

COVINGTON, GA.—W. G. Flake, of Conyers, president of the Panola Light & Power Company, writes that this company has in contemplation the extension of its lines to Covington, at a cost of about $15,000 to $20,000.

AURORA, ILL.—The Fox River Light, Heat & Power Company records its name changed to Western United Gas & Electric Company and capital increased from $500,000 to $6,500,000.

BLUFFS, ILL.—Mr. Henry Knoppel, secretary of the Bluffs Exchange Telephone Company, together with Mr. Fred Brockhouse, expects to start an electric light plant in this place in the spring.

INDIANAPOLIS, IND.—Indianapolis capital has recently been invested in a mammoth power plant in Colorado. Dr. Henry Jamison is president and F. B. Schmid, secretary.

SHIRLEY, IND.—B. T. Martindale, secretary of the Commercial Club, writes that bids will be received about May 1 for the construction of water works and an electric light plant at a probable cost of from $15,000 to $25,000. All communications should be addressed to him.

HUNTINGTON, IND.—This city, it is stated, has been successful in the management of a municipal lighting plant. One hundred and four lamps are in use, and on the basis of cost for the months of September, October, November and December, the cost per lamp per year is $43.14.

JERSEYVILLE, ILL.—Stockholders of the Jerseyville Illuminating Company, Feb. 3, decided to take over the plant of the Jerseyville Light, Heat & Power Company, which now operates the lighting plant of the city. The members of the selling company are practically the same as the ones comprising the new concern. The illuminating company also decided to erect a hot-water heating plant. The company also decided to run both a day and night circuit for lighting purposes, and also for furnishing day power. The proposals to increase the capital stock to $100,000 and also to remove the power plant from its present location at Pearl and Lafayette streets to a point near the Chicago, Peoria & St. Louis Railway station were also considered. These will be decided at a later stockholders' meting in Jerseyville.

AMES, IA.—Proudfoot & Bird, of Des Moines, are preparing plans for a central heat, lighting and power plant, to be constructed at Ames for the Agricultural College, to cost about $75,000.

WATERLOO, IA.—The Peterson Heat, Light & Water Company, of Des Moines, is about to petition Council for a franchise to install a system in Waterloo. Oscar F. Peterson, of Des Moines, is president.

LACROSSE, KAN.—The question of issuing $25,000 water and light bonds is under consideration.

SHEFFIELD, MASS.—The Sheffield Lighting & Power Company has been incorporated by W. Taylor Day and Geo. de P. Fox, both of Great Barrington, to furnish light and power in Sheffield.

SPRINGFIELD, MASS.—The Committee on Public Lighting has given a hearing on the petition of W. S. Kelley for an act to revive the corporate powers and to confirm the acts of the Hoosac Electric Power Company. It is proposed to get money from Readsboro, Vt., and distribute power to Monroe, Florida, Clarksburg, Williamstown, Adams and North Adams.

DOWAGIAC, MICH.—D. E. Connine, superintendent of the electric light plant, writes that the plant will probably be remodeled at a cost of $1400.

HIBBING, MINN.—The Hibbing Water, Light & Power Company has been incorporated by D. D. Crowley, H. A. Liedel and John W. Day, to establish a water, light and power plant; capital, $50,000.

ROYALTON, MINN.—Bonds to the amount of $10,000 have been sold, to be used for the construction of an electric light plant.

FORT BENTON, MONT.—The Benton Electric Light Company has been incorporated at Fort Benton with a capital stock of $15,000. The incorporators are John Harris, W. K. Harbor, Charles Lepley, John V. Carroll, C. H. Evers and L. D. Sharp. The company will build a hydro-electric plant for lighting the town.

ST. LOUIS, MO.—The sale of the St. Louis syndicate's interest in the Union Electric Light & Power Company and the Laclede Gaslight Company to the North American Company, has been officially confirmed by Julius S. Walsh, president of the Union concern. It is announced that the syndicate got a little less than $3,000,000 worth of North American stock in exchange for its Laclede and Union stock of $6,000,000 par value. The Mississippi Valley Trust Company will act as agent of the North American in taking up the stock sold and issuing the new North American stock to the members of the syndicate. Several of the St. Louis capitalists are to be taken into the North American board of directors.

HIGHLANDS, N. J.—The question of constructing water works and an electric light plant here is being discussed. P. N. Cornwall is Mayor.

RAHWAY, N. J.—The Carteret Electric Light, Heat & Power Company at a meeting of the stockholders decided to sell its stock to the Public Service Corporation.

LAKE PLACID, N. Y.—The Paul Smith Hotel Company has purchased the Saranac Lake Light, Heat & Power Company, the capital of which is $100,000. This company has furnished the village of Saranac with light, and it understood that the plant is to be made part of a large system to be created by the Paul Smith Hotel Company. The latter is the owner of the Franklin and Union Falls water powers, which are to be developed, and the power used for lighting Lake Placid and Saranac Lake and for operating the electric road now in process of construction between Lake Clear Junction and Paul Smith's Hotel on Lower St. Regis Lake.

CHARLOTTE, N. C.—At Goldsboro where the city has bought the water and electric light plants, there is much agitation over the question of rates charged by the city and it is rumored that unless matters are satisfactorily adjusted, the courts will be appealed to.

MARION, OHIO.—The Marion Railway, Light & Power Company plans to make important improvements in its electric light system during the coming summer, at a cost of $50,000 or $60,000. The entire overhead system will be overhauled to make it uniform. The railway system will also be improved.

LORAIN, OHIO.—The bill rendered by the local lighting company for electricity for the water works, it is stated, was so high that the Board of Public Service has been aroused to action and has resolved to take steps toward the installation of a municipal lighting plant. Estimates are being solicited for machinery, etc., and it is proposed to install a small plant as a beginning, with sufficient power to supply lights for the city buildings. The intention is ultimately to light the city from its own plant.

SHERBROOKE, ONT.—The contract between the city of Sherbrooke and the Sherbrooke Power, Light & Heat Company for lighting the streets having expired, the company has made an offer to the city that if a contract for 10 years is entered into, it will reduce the $60 rate for street lighting to $50, and give a discount of 10 per cent. on the meter rate.

The Electric Railway.

SACRAMENTO, CAL.—There has been introduced in the Senate a bill to compel street railway companies operating in the State to equip all of their cars with air brakes.

WASHINGTON, D. C.—The annual report of the Capital Traction Company, of Washington, shows that during the year ending December 31, the receipts of the company were over $1,540,000. Over 35,000,000 passengers were carried during the year.

WASHINGTON, D. C.—Improvements calling for the expenditure of about $200,000 are to be made by the Washington, Alexander & Mount Vernon Electric Railway. Perhaps the most important new work to be undertaken is the double-tracking of the line from Alexandria to the southern shore of the Potomac River.

WASHINGTON, D. C.—The first of the hearings has been held on the proposal of Representative Cowherd to compel a reduction in fare per passenger to 3 cents upon the lines of the Washington Railway & Electric Company and the Capital Traction Company. General Harries, of the Washington Railway & Electric Company, and President Dunlop, of the Capital Traction Company, both appeared in opposition to the measure, and quoted figures to prove that the roads could not be made to pay at the reduced fare.

WASHINGTON, D. C.—A bill authorizing the Washington Railway & Electric Company to operate automobile lines in the district has been introduced in the House by Representative Allen, of Maine. The bill specifies that the automobile lines shall not operate on streets already occupied by street car tracks, except in time of emergency or for a distance of not more than 1000 feet; that the rate of fare shall not exceed 5 cents for each passenger; that the six tickets for a quarter now sold by existing street railroad corporations shall be accepted as fare; that free transfers shall be exchanged with the Washington Railway & Electric Company at designated points; that the automobiles shall not run at a greater speed than fifteen miles an hour south of Florida Avenue, nor eighteen miles an hour north of that thoroughfare, and that 1 per cent. of the gross earnings of the automobile lines shall be paid annually to the district. The measure has been referred to the district committee for report.

PEORIA, ILL.—Important improvements are to be made by the Peoria & Pekin Terminal Railway Company.

CHICAGO, ILL.—The Chicago & State Line Railway Company has been formed to build a connection with the Chicago & Northwestern Railway, near Lake Bluff, Lake County, Ill., to the northern boundary line of Illinois. Capital, $10,000; incorporators and first board of directors are Kirkman, Evanston, Ill.; H. R. McCullough, Lake Forest, Ill.

LAKETON, IND.—There is an opening here for an electric railway system.

ANDERSON, IND.—Frank Houghman announces that the line for the proposed Toledo, Celina & Indianapolis Traction line will be surveyed early in the spring, and will include both Perkinsville and Noblesville.

DETROIT, MICH.—The Detroit United Railway has contracted for an additional 2000-hp unit. The building of the Detroit Citizens' power house is being enlarged to accommodate the additional machinery, which is already on the ground.

JACKSON, MISS.—The Durant-Lexington Electric Railway Company has been organized to build an interurban line between the towns of Lexington and Durant; capital stock, $200,000. The incorporators are Chester Jones, Truman Jones and W. O. Glines.

SEDALIA, MO.—The Transit Company, composed of Sedalia and St. Louis capitalists, recently secured possession, by lease, for a long term of years, of all the street railways now in operation in this city, together with the power plant, rolling stock, railway plants, electric lighting plant, franchises and real estate. The officers of the new company are: H. S. Rumsey, St. Louis, president; Joseph Clarke, St. Louis, vice-president; W. H. Powell, Sedalia, secretary and treasurer; Robert B. Hammer, Sedalia, general superintendent. The new company proposes to expend $100,000 in improvements within the next six months.

ALBANY, N. Y.—Senator Lewis, of Rochester, has introduced a bill for compulsory arbitration when strikes take place among employees of public service corporations.

NEW YORK, N. Y.—Announcement is made that the New York & New Jersey Tunnel Company will begin work on the new subway up Sixth Avenue to connect with the tunnel under the Hudson River to Jersey as soon as the Mayor signs the franchise granted by the Board of Aldermen.

NEW YORK, N. Y.—Senator Saxe is introducing a bill at Albany to allow the New York Central to change its Eleventh Avenue freight line into a subway and to change its location if desired; to carry passengers in the new subway if desired; and to receive an additional 25-year franchise for new tracks in the subway.

WHITE PLAINS, N. Y.—Plans for the new electric service between the Grand Central station and White Plains on the New York & Harlem Railroad Company's lines have been completed by the New York Central. A syndicate a large tract of land in White Plains near the proposed new station. Part of composed of interests closely identified with the Central management has bought it will be used by the road.

NEW YORK, N. Y.—The representative of August Belmont has stated to the Westchester board of improvements that City Island is soon to have a new trolley line running from Bartow Station to the end of City Island, the proposition being contingent upon the widening of the streets. He added that the line would be operated, as regards fares, in connection with the New York, New Haven & Hartford service.

ASHEVILLE, N. C.—It is reported that an electric railway will be built between here and Henderson, a distance of 28 miles.

BARBERTON, OHIO.—The Wadsworth & Western Traction Company has been incorporated by B. W. Clendenning, G. H. Heffner, Wm. A. Ault, Chas. S. Johnson, S. Cunningham and H. S. Davidson. The company proposes to build first from Barberton to Wadsworth to give the latter place connection for Cleveland, and it is also stated that the road may be extended to Creston and Seville, where connection will be made with the Cleveland & Southwestern.

GUTHRIE, OKLA.—The Guthrie Railway Company, with offices at Guthrie, Okla., and Pittsburg, Pa., was chartered Jan. 14, to build an electric railway from Edmond, Okla., to Guthrie. The length of the railroad is 20 miles, and its estimated cost $600,000. Its capital stock is fixed at $300,000. Its directors are George H. Braner and W. J. Faulkner, of Oklahoma City, and J. A. Cottingham, G. M. Green and L. N. Bradley, of Guthrie.

NASHVILLE, TENN.—A meeting was held here recently of managers and officers of the properties in which Ford, Bacon & Davis, of New York, are interested. Delegates to the meeting were in attendance from New York, Birmingham, Little Rock, Knoxville and Nashville. An inspection was made of the Nashville system, after which there was a general discussion as to the operating features of the system.

CLARKSVILLE, TEX.—There is an opening here for an electric railway line. A large and prosperous farming community would be thus served and a bonus would be given, or $100,000 subscribed for such a project. Mr. John B. King, president of the Home Telephone Company, or Mr. B. F. Fitz Gerald, secretary of the same company, can possibly give further information on this subject.

NORTHFIELD, VT.—The incorporators of the electric road are taking bids for the new power house and dam for the new trolley system, which will connect Millers' Falls and Northfield.

SPOKANE, WASH.—The Spokane Southern Traction Company has announced plans to build 10 miles of interurban road south from Spokane by August 1.

SPOKANE, WASH.—The Spokane & Columbia River Railroad Company has secured a water power in the Spokane River, 25 miles below this city where it can develop 20,000 electrical horse-power. The company expects to build a $50,000 concrete dam and furnish electric power to Davenport and other towns of the Big Bend country.

OTTAWA, ONT.—Application has been made to Dominion parliament for a bill of incorporation of the Canada-Middlesex Railway Company, with power to construct an electric railway from Niagara Falls, through the counties of Welland, Lincoln, Wentworth, Brant, Oxford and Middlesex, Ont., to a point near the city of London, Ont. The headquarters of the company are to be in Toronto. The capital stock is $500,000, and power is asked to issue debentures to the extent of $35,000 per mile.

HAMILTON, ONT.—Hon. C. D. Haines, of New York, who has made arrangements for the building of the Ancaster & Brantford Electric Railway, has made an offer to purchase the street railway of the city of Hamilton. His line was refused an entrance to the city, on the streets applied for. The street railway is now owned by the Cataract Power Company, and the franchise matures in 1928. The road has a bond issue of $500,000, and its receipts for the past year were $219,594.

TORONTO, ONT.—Radial railways will be in operation between Toronto and Oakville, 20 miles; Toronto and Jackson's Point, 50 miles, and Toronto and Whitby, 26 miles, at the close of the present year, according to the plans of the Toronto & York Radial Company, otherwise known as the Toronto Railway Company. Surveyors are at work selecting a route for the uncompleted portions of these roads and securing options on property. Construction work will be resumed in the early spring.

OTTAWA, ONT.—The report presented at the annual general meeting of the Ottawa Electric Railway Company, for the year ending Dec. 31, 1904, shows gross receipts of $384,939. The net earnings were $139,097. Four quarterly dividends of 2 per cent. each were declared, amounting to $79,456. The number of passengers carried during the year was 8,717,205, an increase of nearly one million over last year. At the directors' meeting Mr. T. Ahearn was re-elected president, Peter Whalen, vice-president, and J. D. Fraser, secretary-treasurer.

OTTAWA, ONT.—It is understood that the Ottawa River Railway Company has awarded the contract for the construction of the proposed new railway between Montreal and Ottawa to M. P. McGrath, of Easton, Pa. This new project, for which the charter was obtained some time ago, and which is to be largely dependent upon United States capital, is to be undertaken partly as a steam and partly as an electric road. When realized, city and suburban business will be conducted by electrical power, while the main line will be operated as a steam railway. The first section is to be built between Montreal and Hawkesbury, and the plans for this have been approved by the Dominion government. Ultimately, the idea is to extend the line as far as the Georgian Bay. Amalgamation is to take place with the company chartered by the Ontario Legislature. This will give the shortest route between the great lakes and Montreal.

MONTREAL, QUE.—The Montreal Terminal Railway Company is petitioning Dominion parliament for power to issue stock; to increase its bonding privilege, and to construct branch lines operated by electricity in Hochelaga, Maisonneuve, Jacques Cartier, Chambly, Vercheres, Laprairie, St. Johns, Iberville and St. Hyacinthe; also to distribute electric power for lighting, heating and other purposes.

QUEBEC, QUE.—Notice has been given that Messrs. J. W. Molson, A. B. Cruchet and J. Brosseau will apply to the Legislature at its coming session for an act of incorporation under the name of the Lake Achigan Electric Railway Company to build and operate an electric railway connecting the town of St. Jerome with Lake Achigan, Que., through the parish of St. Jerome, Shawbridge and the parish of St. Hypolite, and another electric line through St. Jerome, Ste. Sophie and New Glasgow.

New Industrial Companies.

THE BATY PLUMBING & ELECTRIC COMPANY, of Paris, Tex., has filed articles of incorporation. The incorporators are H. R. Baty, H. P. Myers and J. L. Collins.

THE DULUTH ELECTRIC & CONSTRUCTION COMPANY has been formed; capital, $50,000; incorporators, Charles A. Hutchinson, Harold E. Pierce and Van S. McKenny.

THE KERR ELECTRIC COMPANY, of New York City, has been incorporated with a capital stock of $1000. The directors are D. A. MacIntyre, O. B. Goldsmith and A. L. Davis, New York.

THE ADAMS STORAGE BATTERY COMPANY, of Camden, N. J., has been incorporated with a capital stock of $4,000,000. The incorporators are E. G. C. Bleakly, Joseph Tyler and Henry F. Stockwell.

THE TIMES SQUARE AUTOMOBILE COMPANY, of New York City, has been incorporated with a capital stock of $10,000. The directors are Morris Roechlich, Jesse Froehlich and Frederick Bloch, New York.

Legal.

GROUT INQUIRY ILLEGAL.—Controller Grout's investigations of New York City's lighting situation received a rebuff last week when Supreme Court Justice Marean, of Brooklyn, handed down a memorandum in which he states that it was an unconstitutional statute under which Controller Grout tried to punish officers of the lighting companies for their refusal to answer questions which he put to them. Justice Marean, however, holds that the case is so important that the Appellate Division should pass on the question before it be considered settled. The memorandum was filed in the proceeding which the Controller's private counsel brought to compel Joseph Williams, the assistant secretary of the New York Edison Company, to answer questions as to the cost of producing and distributing power to the city for lighting purposes. On hearing the arguments in the contempt proceedings, the justice issued a warrant for Williams' arrest, but at the same time issued a stay of proceedings with the understanding that the case immediately be taken to the Appellate Division. The memorandum which was filed by the Justice was supplemental, but indicated that the justice, on examining the law, had come to the same conclusions as had Corporation Counsel Delany in his advice to Mr. Grout before the inquiry began, being to the effect that the Controller had no power to enforce such investigation as he tried to carry on.

Personal.

MR. F. H. GALE, of the General Electric Company, has been put in charge of the company's publicity bureau in New York City.

MR. H. H. HUMPHREY is lecturing this week before the Engineers' Club of St. Louis on "Industrial Electric Power Plants."

MR. E. W. BENTLEY, M. E., has opened an office in the Bessemer Building, Pittsburg, for the A. D. Granger Company, contracting engineers.

MR. JOHN W. LIEB, JR., president of the American Institute of Electrical Engineers, has become a member of the John Fritz gold medal award committee.

MR. FREMONT WILSON, consulting electrical engineer and fire hazard expert, has established his new offices in the Metropolitan Life Building, Madison Avenue, New York.

MR. FRED DE LAND has contributed recently to the *Pittsburg Leader* a very interesting sketch of Prof. A. G. Bell's work on behalf of the deaf and dumb—a philanthropic and useful work full of benefaction to mankind.

MR. CHAS. C. DEERING, secretary of the Iowa Telephone Association, has resigned as superintendent of the Des Moines Mutual Telephone Company to become manager and secretary of the Boone County, Ia., Telephone Company.

MR. THOMAS B. PECK, JR., secretary of the United Telpherage Company, who was married on January 14, and has been absent from the city for a few weeks, has returned. Mr. and Mrs. Peck passed about a fortnight in Quebec, and made visits to friends and relatives.

MR. W. L. BIERSACH sailed Feb. 13 for Europe, where he will inspect, as personal representative of Messrs. L. L. Nunn and P. N. Nunn, the third shipment of hydraulic machinery being made at the works of J. M. Voith, Heidenheim, Germany, for the Ontario Power Company, of Niagara Falls.

MR. ALBERT E. SINK, who for over 20 years has been manager of the operating department of the Western Union Telegraph Company's main office at 195 Broadway, New York, has resigned. Mr. T. A. McCammon, Mr. Sink's assistant, has been appointed to fill the position. The change took place on Feb. 13.

MR. C. A. MORENO.—Officials of the Transit Company and the United Railways Company, St. Louis, Mo., a few evenings ago presented to Chief Engineer C. A. Moreno a handsome silver dinner service of 200 pieces, the occasion being his retirement from the employ of the United Railways, to take up private practice.

WALKER & GREEN have established themselves at 500 Union Trust Building, Detroit, Mich., as consulting engineers, particularly in the field of public utility corporations and industrial enterprises. Mr. James Walker was formerly engineer to the Michigan Board of State Tax Commissioners. The other member of the firm is Mr. M. M. Green.

MR. W. K. PALMER, consulting engineer, 718 Dwight Building, Kansas City, Mo., has secured a contract to prepare plans and specifications and superintend the building of the new electric lighting plant and lighting system for the Higbee Electric Light, Heat & Power Company, at Higbee, Mo. Plans and specifications will be ready in about 10 days and will be on file in the office in Kansas City.

MR. T. A. EDISON celebrated his fifty-eighth birthday at Llewellyn Park on February 11, and received many messages, visits and telegrams of congratulation. He is still suffering a little from the recent operation for mastoiditis, but is recovering rapidly. Last week he gave sittings to Mr. Fraser, the sculptor who is designing the Edison medal for the American Institute of Electrical Engineers.

MR. C. T. YERKES.—Advices from London state that Mr. Robert W. Perks has resigned the acting chairmanship and Mr. Charles T. Yerkes, of Chicago, has been elected chairman. Mr. Yerkes henceforth will take the active and entire management of the road. The electrical installation is practically complete over the entire 48 miles of the system and only awaits the delivery of the cars to begin actual working.

MR. H. H. PEASE, for several years connected with the Nernst Lamp Company, has recently assumed charge of the Pittsburg territory for the C. & C. Electric Company and has offices in the Park Building, Pittsburg. Mr. Pease, well known by the electrical fraternity, is an energetic representative of high executive and technical ability, and enters this new field, making a specialty of complete isolated lighting plants and variable speed motors for driving machine tools.

COMMANDER B. A. FISKE.—The annual prize of the Naval Institute, composed of United States naval officers, awarded in open competition for any paper on a naval subject, has been won by Commander Bradley A. Fiske, whose paper was entitled "American Naval Policy." The prize consists of a gold medal, $200 in cash and life membership in the institute. Commander Fiske is well known and highly esteemed in electrical circles as one who has devoted time, attention and inventive ability to the solution of many electrical problems of difficulty.

MR. H. E. OVERSTREET, of Chicago, constructing contractor, who is in charge of the construction of the wireless telegraph stations for the United States Navy Department at Key West, Fla., Guantanamo, Cuba, Colon, Panama, and San Juan, P. R., has sailed from New Orleans on the steamship Ellis. Mr. Overstreet came up from Guantanamo but a few weeks ago, where he recently completed the wireless station there. The station at Key West was completed Dec. 30 and is now ready for operation. The Colon and San Juan stations will be ready to receive the wireless instruments in about six weeks.

MESSRS. SPRANLEY & REED have just accepted the district managership of the National Electric Company for New Orleans and the surrounding country. They will be remembered as having represented the Bullock interests prior to this time. Mr. W. T. Spranley is one of the oldest operators in the electrical field in that section of the country. Mr. Lyman C. Reed, formerly with the Interstate Electric Company and Safety Electric Company, is one of the best known electrical engineers in the South. Both of these gentlemen are thoroughly well known in that section of the country, and their numerous friends will be interested in this announcement.

MR. A. W. WYCKOFF has been appointed district manager of the National Electric Company for Pittsburg and the surrounding territory. Mr. Wyckoff is well known in that section, as he was previously district manager of the Bullock Electric Manufacturing Company, having been, prior to his taking the Pittsburg office, the general superintendent of the Bullock works at Cincinnati. Mr. Wyckoff is a graduate of Cornell, and rounded out his engineering education in the Bethlehem Steel Works. He has already started the ball rolling for the National Electric Company by securing an order for the five 300-kw, 120 r.p.m., engine-type generators for the Carnegie Institute.

MR. H. S. REYNOLDS, who has managed for the last four years the Stone & Webster interests in Columbus, Ga., which consisted of all the street railway, electric light and gas properties in that city, has resigned to accept a position in the operating department of J. G. White & Company, engineers and contractors, 43 Exchange Place, New York, where he will reside in the future. Before going to Columbus, Ga., Mr. Reynolds was connected with the Brockton, Mass., Street Railway Company, in charge of construction. He is a graduate of the Massachusetts Institute of Technology, class of 1894, and since graduation has devoted his entire time to the construction and operation of street railway, electric light and gas plants.

PROF. R. L. GARNER, a naturalist and a student of the language of monkeys, will go to the west coast of Africa, where he will make his headquarters at Gaboon and Cape Lopez. From these places he will make his observations of monkey life, their speech and habits. The material for his trip includes a ton of iron for his famous cage, in which he sits while making observations. He also carries with him one of the most complete and most delicate phonographic outfits ever manufactured. These machines were made under the personal direction of Mr. Edison. They are so sensitive that they will record the slightest jungle noise. It is by means of such mechanisms that he has been enabled to compare the various monkey articulations and then formulate them.

PROF. C. F. BURGESS.—The Carnegie Institution has recently made a grant of $2500 to Professor C. F. Burgess, of the Department of Applied Electrochemistry, of the College of Engineering, University of Wisconsin, to aid him in carrying out investigations upon the properties of pure iron and its alloys. During the past three years Professor Burgess has developed a method of producing iron electrolytically of a very high degree of purity, in a manner similar to that employed in the refining of copper. Previous to this work pure iron had been obtained only in very small quantities and at excessive cost, but Professor Burgess is now able to produce comparatively large quantities at a small cost, using for this purpose a cheap grade of steel. Careful analysis of this product fails to show the presence of any foreign element, with the exception of hydrogen, which can readily be driven off by heat. There is already a considerable demand for this iron for scientific purposes, and about half a ton has already been made.

News of the Trade.

NEW COMPANIES.—The Edison Appliance Company, the Edison Repair & Supply Company, the Edison Light Company, the Edison Electric Illuminating Company, and the Edison Equipment Company, each with a capital of $2500, have been incorporated by Clayton R. Taylor, Percy B. Eckhart and Thomas G. Deering.

MECHANICAL DRAFT.—The rapid introduction of mechanical draft as a substitute for chimney draft has been noticeable. A recent installation of considerable interest is that made by the B. F. Sturtevant Company, of Boston, Mass., for the Marquette Manufacturing Company, La Salle, Ill., where ten 150-H.P. horizontal tubular boilers have been equipped with a large engine-driven fan applied as a substitute for the chimney to induce draft through the grates.

THE EMPIRE STATE DRY BATTERY COMPANY, 70-76 Fulton St., New York, is experiencing a tremendous demand for its "White Star" dry battery, which, although it has been on the market but a short time, has convinced the most skeptical of its merits. The Empire State Company informs us that it does not belong to any "combine" or "trust," and will continue to keep out of any such relationships. It has a neat little folder describing the various uses of its battery, which it is sending out to the trade.

THE WATERTOWN ENGINE COMPANY has just issued a report of tests on Watertown single-valve engines under conditions of actual service, giving full details of the averages of observations made upon two 37½kw Fort Wayne generators, coupled direct to 10-in. x 12-in. Watertown high speed engines for the electric lighting system of the upper and lower Roxboro filters for the Department of Public Works, Philadelphia. Under full load, the two units required .8 and 2.3 less pounds of steam per kw-hour than specified by contract, while at half load the corresponding figures were 2.5 and 3.5 pounds respectively. The representative for the city, Mr. Harry M. Hillegas, states that during the four tests, each lasting 10 hours, the engines and generators ran smoothly and satisfactorily.

CENTRAL ELECTRIC COMPANY BURNED OUT.—The offices and warehouse, at Chicago, of the Central Electric Company were entirely destroyed by fire Feb. 11. In a notice sent out by the company it states that while the fire has temporarily interfered with its business it will take prompt care of orders. The company is established at temporary quarters at 209 E. Jackson Boulevard, and hopes to have its business again running smoothly in a few days with a full new stock of supplies. The new quarters at 209 Jackson Blvd., were arranged for within one hour after the time for the opening of the office. Before noon the company had complete office equipments, including typewriters, desks and new stationery, and by ten o'clock at night it had sent out to its trade 10,000 announcements of the fire and the continuance of business. This work shows great hustling qualities.

Trade Publications.

H. T. PAISTE COMPANY continues to issue some novel circulars, slips, etc., relative to its fixtures and specialties, including its P. K. panel cutouts and boxes, P. K. cartridge fuse cutouts and other things like rosettes, window lighting appliances, etc.

OIL SWITCHES AND CIRCUIT-BREAKERS.—Circular No. 1096 of the Westinghouse Elec. & Mfg. Company is devoted to oil switches and oil circuit-breakers. Each type of this apparatus is illustrated by an excellent half-tone, accompanying a text giving a detail description. Circuit breakers are shown for voltages up to 60,000.

THE INTERNATIONAL TELEPHONE MFG. COMPANY, Chicago, has issued a very attractive price list in booklet form, which is ready for distribution. The prices, considering the quality of apparatus furnished, are attractive as well as the booklet itself. The list covers a full line of telephones, telephone parts and supplies, and will interest every exchange manager figuring on extensions.

PAINT.—There has recently been sent us a copy of "Protection, Resistance, Durability," a handsome and interesting booklet describing the methods of manufacture in the electric furnace and use of Acheson graphite for paint pigment. Any one interested in protecting metal surfaces from corrosion and decay would do well to write for this booklet to the International Acheson Graphite Company, Niagara Falls, N. Y.

THE WARD LEONARD ELECTRIC COMPANY, of Bronxville, N. Y., has issued a new catalogue covering its motor-starting rheostats. The prices have not been increased but the cuts and descriptions show clearly that many unique and important features have been carefully worked out in their new designs. The standard of construction has been raised, and it is claimed that the new motor starters are as "fool proof" as rheostats can be constructed.

PENBERTHY STEAM SPECIALTIES.—Catalogue No. 21 of the Penberthy Injector Company contains 64 pages and about 100 illustrations, the latter showing in greater or less detail all of the various types of Penberthy injectors, lubricators, water alarms, gage cocks, etc. Among the new devices shown is a grease cup, known as the "Sargon," having the thread on the stem instead of on the body of the cup.

THE DOUBLEDAY-HILL ELECTRIC COMPANY has just issued a comprehensive net price catalogue of repairs and repair parts of field coils, armature coils, armatures, switchboards, etc. This company possesses the necessary facilities for repairing larger apparatus up to 1500-kw of any make, and for recontructing dynamos for different speeds and voltages. Any one who is in the electrical business will be furnished with a copy of the above catalogue upon application to the company, 919 Liberty Street, Pittsburg, Pa.

HOLOPHANE SHADES.—With the title "Light vs. Illumination," the Holophane Glass Company, 15 East 32d Street, New York, has issued a neat pamphlet, setting forth the principles of illumination and the reasons why the Holophane globe enables the best kind of illumination to be obtained. A distinction is drawn between light and illumination, and the three factors of good illumination, namely, quantity, quality and proper use of light, are treated in detail.

ROLLER BEARINGS.—The Hyatt Roller Bearing Company, Harrison, N. J., has issued a new bulletin (No. 117) describing and illustrating the standard Hyatt roller car bearings, as adapted to shop-cars, trucks, cranes, trolleys, tumbling barrels and all work involving heavy duty at low speed. The increasing demand for standard Hyatt gear boxes which may be used on shop trucks and yard trucks, led to the design of a standard line of these bearings, and it is to this line that the present publication is devoted.

WOOD STAVE PIPE.—The latest catalogue of the National Wood Pipe Company, San Francisco and Los Angeles, Cal., gives a number of illustrations of pipe line installations, in each case the illustration being accompanied by a letter from the power company giving their experience with the installation. We know of no technical publication in which all the details of the construction and laying of stave pipe lines are so fully illustrated as in this catalogue, and it should therefore have an unusual interest for the engineer whose work extends to hydraulic development.

METAL ENGRAVING.—The George Gorton Machine Company, of Racine, Wis., has issued a catalogue devoted to its line of apparatus for cutting lettering or designs, either sunk or relieved, on metals. By means of the process for which this apparatus is employed, engraved lettering and figures are copied from enlarged models. It is claimed that by this process there may be produced much cleaner and better work with perfect uniformity in repetition ,and four times as much work from one operator, who does not need to be skilled in the art of engraving. The engraving machines are made either belt or electrically driven.

MOTORS AND GENERATORS.—The Robbins & Myers Company, of Springfield, Ohio, has recently issued a very comprehensive price-list of its "Standard" motors and generators. It is side-pocket size and contains most intelligent lists of its various types of motors as regularly furnished for various applications, from 1-16 to 15 horse-power, and dynamos from ½ to 10 kilowatts. Having a very large number of frames giving an unusually wide range of capacities and speeds up to the limit of size, one can readily select from the list motors of standard ratings readily adaptable to most all kinds of electric drives requiring protected ventilated, gauze enclosed or fully enclosed motors. Interested parties can obtain copies by communicating with the company.

THE HARRISBURG FOUNDRY & MACHINE WORKS has just issued a leaflet entitled "Fleming-Harrisburg Engine at the International Exposition, St. Louis, Mo." This publication is a reproduction of an article published in the November 11 issue of the *Engineer* (London), and describes the design and construction, as well as the performance of one of this company's latest productions in its four-valve compound type. The engine was used in connection with the intramural electric transportation system of the Exposition and was in service continually during the entire period of the fair, developing more actual horse-power than any other engine employed in exposition service. The engine received a gold medal and special diploma as highest award in its class by the International Jury, and is well illustrated and described in the article as reproduced, copies of which will be mailed upon request.

DEANE CONDENSING APPARATUS.—The Deane Steam Pump Company, of Holyoke, Mass., has issued a catalogue comprising 104 pages, which describes in detail the numerous types of apparatus manufactured by the Deane Company for engine condensation. The illustrations number more than two score. An interesting introduction gives an account of the principles of steam condensation and the application of condensers to the steam engine. Two tables are included in this portion, one of which shows the increase of power to be obtained by the use of the condenser; and the second is a table of standard engine performances, showing the power that will be developed from a given engine from 1-10 to ½ cut-off when worked non-condensing and also when worked condensing. Indicator cards are here also used to illustrate the advantages of condensation.

THE WESTINGHOUSE-PARSONS STEAM TURBINE.—In an exceedingly attractive catalogue, the Westinghouse Machine Company gives valuable information concerning the steam consumption of its 400-kw, 750-kw, 1000-kw and 1250-kw turbines. Running non-condensing and using saturated steam, the 1000-kw machine requires 22.2 pounds of steam per delivered electrical horse-power-hour at full load. With 100° superheat, the steam consumption becomes 16.8 pounds at the same load. The effect of using a condenser giving a vacuum of 28 in. will be appreciated when it is known that under conditions similar in all other respects to the above, the amount of saturated steam required was 7.7 pounds or 6.4 pounds of steam superheated 100 degrees. A turbine designed for condensing work will not operate non-condensing with quite as good economy as if designed to exhaust against atmospheric pressure.

THE DOUBLEDAY-HILL ELECTRIC COMPANY, of Pittsburg, has recently issued a 24-page booklet devoted exclusively to electrical repairs and repair parts. The repair department was established a number of years ago and has met with such success that it now occupies an entire floor in their large eight-story building where every facility in the way of up-to-date machinery and expert labor is provided for turning out high grade work with great promptness. A recent addition to the scope of this department is the manufacturing of armature and field coils and commutators for all kinds of generators and motors in all horse-powers and voltages. This work was undertaken originally to provide parts of the requisite high quality at short notice for use in connection with repair work and the success they met with has lead the Doubleday-Hill Company to place the coils and commutators on the market as an independent undertaking. The new booklet quotes prices on coils and commutators for all kinds of generators and motors, as well as prices for rewinding and refilling. A scale of prices for single generator switchboards is also included.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEBRUARY 7, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

781,639. RAILWAY SIGNAL; Frank L. Dodgson, Rochester, N. Y. App. filed March 27, 1903. Improvements in that class of signal comprising a counting device at each block for counting in and counting out cars on a block.

781,650. COMMUTATOR BRUSH HOLDER; William Heap and William A. Barnes, Bolton-le-Moors, England. App. filed Aug. 15, 1904. The tension of the spring regulating the pressure on the brush is adjusted by a pawl and ratchet arrangement.

781,661. STRINGER SUPPORT FOR ELECTRIC THIRD RAILS; Frank E. Kinsman, Plainfield, N. J. App. filed July 28, 1903. The rail in the form of a strap is applied to the upper surface of a wooden string-piece, the latter being supported on insulators let into the body of the string-piece.

781,686. BINDING POST; Clarence C. Sibley, Perth Amboy, N. J. App. filed Nov. 24, 1902. A circular spring plate is interposed between the head of the screw and the top of the post, one end of the spring being secured in a slit in the post and the wire being clamped between the head of the screw and the spring.

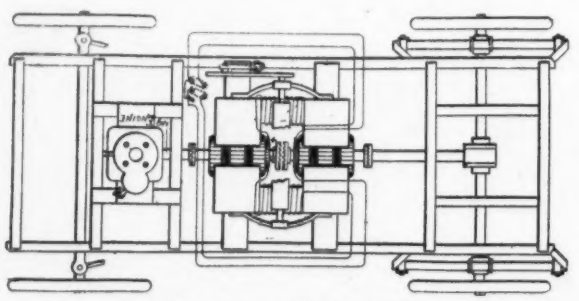
781,706. ALTERNATING-CURRENT GENERATOR; Emil Ziehl, Berlin, Germany. App. filed Sept. 30, 1904. (See Current News and Notes.)

781,721. GUARD FOR TROLLEY WHEELS; Merwin M. Hart, Chicago, Ill. App. filed April 15, 1904. Idle guard wheels are arranged on each side of the trolley wheel and have inwardly directed lugs to retain the wire on the wheel.

781,736. NEUTRAL RELAY; Charles D. Olsen and John M. Kinnear, Denver, Col. App. filed Aug. 1, 1904. To prevent false signals in a quadruplex system, an auxiliary magnet is arranged in series with the relay and holds the armature against one of its stops, thereby preventing the sounder lever from making false signals upon reversal of the current.

781,752. TELEGRAPH; Frank A. Stumm, New York, N. Y. App. filed Dec. 4, 1902. Method of balancing the line consisting in ascertaining the mean variation of the main circuit from a predetermined normal, increasing the resistance of the main line circuit to an extent proportionate to the variation thus determined and balancing the main line circuit with its resistance thus increased.

781,686.—Binding Post.



781,968.—Dynamo Electric Machine.

781,937. ELECTRIC ARC LAMP; Albert G. Davis and John E. Hubbell, Schenectady, N. Y. App. filed July 7, 1904. Means for puncturing a film or coating of inductive material which may have been formed on one or both of the electrodes, to facilitate the passage of an arc.

781,938. VAPOR ELECTRIC APPARATUS; John T. H. Dempster, Schenectady, N. Y. App. filed June 27, 1904. (See page 349.)

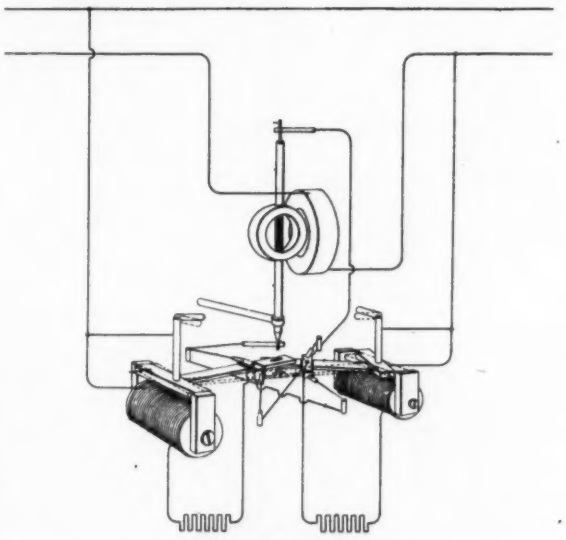
781,945. ELECTRIC METER; Edward S. Halsey, Chicago, Ill. App. filed March 13, 1902. A stationary return path for Foucault current generated in the brake disk, said path being composed in part of an alloy having a low temperature coefficient.

781,957. FIELD MAGNET CORE FOR DYNAMOS AND MOTORS; Keijiro Kishi, Tokio, Japan. App. filed Aug. 25, 1902. A bunch of iron wires cast into the yoke piece and extending to the pole face.

781,962. TROLLEY; Edward H. Miller, Pittsburg, Pa. App. filed Sept. 30, 1904. Threads arranged on cylinders each side of the trolley wheel to conduct the wire towards the wheel in case it leaves the same.

781,968. DYNAMO ELECTRIC MACHINE; Joseph Sachs, Hartford, Conn. App. filed Sept. 19, 1903. A machine adapted to drive vehicles comprising two or more armatures, means for producing a magnetic field and other means for obtaining inversely varying flux through the armatures.

781,984. MAGNETIZABLE CONDUCTOR CONDUIT SYSTEM; William J. Alexander, Philadelphia, Pa. App. filed July 1, 1904. A magnetizable conductor located in a closed conduit and divided into convenient lengths for removal should any length become damaged, with devices for taking up slack and for securing the ends of the cable divisions.



782,030.—Electric Meter.

781,757. AUTOMATIC SYSTEM OF SIGNALING FOR ELECTRIC RAILWAYS; Samuel M. Young, New York, N. Y. App. filed Nov. 15, 1904. The system contemplates the employment of a selective relay, a circuit controlled by such relay and visual signaling apparatus actuated directly by the current flowing in the circuit controlled by the relay.

781,762. ELECTRICAL DENTAL FURNACE; Luther L. Bosworth, Cleveland, O. App. filed March 5, 1904. A two-part separable muffle having one part telescoping the other and a heating coil covered in between the parts.

781,785. CIRCUIT CONTROLLER; Louis Pfingst, Boston, Mass. App. filed April 4, 1904. A circuit controlling handle is mounted upon an ordinary brake handle and can be actuated at will with the latter.

781,793. SANITARY ATTACHMENT FOR TELEPHONES; Isaac M. Slocum, Boston, Mass. App. filed June 22, 1904.

781,797. TELEPHONE RECEIVER; Axel R. Thollander, Chicago, Ill. App. filed Oct. 1, 1904.

781,805. SYSTEM OF ELECTRICAL DISTRIBUTION; Theodore Bodde, Schenectady, N. Y. App. filed Nov. 18, 1903. (See Current News and Notes.)

781,823. TELEGRAPHY; William C. A. Hammel, Baltimore, Md. App. filed Sept. 4, 1900. Details.

781,873. WIRELESS TELEGRAPHY; Patrick B. Delany, South Orange, N. J. App. filed July 10, 1903. When the coherer has acted to control the local circuit and thereby actuated the relay, the winding of the latter is shunted, so that its movable part or armature is free to return at once; such an arrangement permitting of lower adjustment and a more sensitive device.

781,878. DYNAMO-ELECTRIC MACHINE; Henri Amedée Emile Harle, Paris, France. App. filed Aug. 12, 1902. (See Current News and Notes.)

781,888. TELEPHONY; Isidor Kitsee, Philadelphia, Pa. App. filed April 4, 1901

781,919. SYSTEM OF ELECTRICAL DISTRIBUTION; Charles W. Stone, Schenectady, N. Y. App. filed Sept. 30, 1901. (See Current News and Notes.)

781,931. MEANS FOR PROTECTION AGAINST SHORT CIRCUITS; Charles E. Barry, Schenectady, N. Y. App. filed July 15, 1904. In case a short circuit occurs between the contact shoe and the car truck, a circuit breaker is arranged to cut out that section of the feeder supplying the shoe.

781,932. ALTERNATING CURRENT APPARATUS; Edward Bennett, Pittsburg, Pa. App. filed Oct. 13, 1902. The iron parts are so proportioned with reference to an air gap that the portion which supplies the greatest number of lines of force will be saturated at or below the minimum current ever used; in this way there is no increase of induction when larger currents flow which would cause increased stresses that are productive of noise.

781,993. CIRCUIT CLOSER; Walter J. Bell, Los Angeles, Cal. App. filed Oct. 9, 1903. A magnet carried by a car attracts and lifts a body of iron filings into bridging contact with two terminals in order to convey current to the car.

782,007. THIRD RAIL; Leonard T. Crabtree, Crandon, Wis. App. filed April 14, 1904. Details.

782,030. ELECTRIC METER; Frank Holden, Rugby, England. App. filed Sept. 23, 1903. To avoid the use of a commutator the two ends of the armature shaft are insulated from each other and the terminals of the armature winding are respectively connected with said ends. Light reversing switch which is automatically operated at every half-revolution brushes bear on the pivots of the shaft and connect the winding with a of the armature.

782,038. THERMAL CUT-OUT; Charles E. Lockwood and George A. Lutz, New York, N. Y. App. filed Oct. 28, 1903. Bayonet joints secure the caps on the ends of a cartridge fuse.

782,054. INDUCTION MOTOR; Henry G. Reist, Schenectady, N. Y. App. filed July 11, 1904. A number of U-shaped conductors connecting a plurality of the rotor conductors to a conducting ring to afford a simple means for attaching the short circuiting rings.

782,066. AUTOMATIC ALARM TELEGRAPH; Albert D. Shaw, New York, N. Y. App. filed April 15, 1904. Details.

782,099. TELEGRAPH SYSTEM; William E. Athearn, Brooklyn, N. Y. App. filed June 2, 1902. Details.

782,100. SIGNALING APPARATUS FOR ELECTRIC RAILWAYS; Walter C. Bethel, Seattle, Wash. App. filed Nov. 4, 1904. Details.

782,131. ELECTRIC TEMPERATURE ALARM; Cowan P. Hepler, Smithton, Pa. App. filed Feb. 20, 1904. A thermometer arranged in a tank closes an electric circuit when the temperature of the contents of the tank arrives at a certain point.

782,181. WIRELESS TELEGRAPHY; George Owen Squier, San Francisco, Cal. App. filed Nov. 10, 1904. (See Current News and Notes.)

782,195. TROLLEY POLE CONTROLLER; Clarence V. Greenmayer, Los Angeles, Cal. App. filed Feb. 4, 1903. By means of pneumatic pressure the pressure of the trolley wheel upon the wire is controlled and the pole is withdrawn in case the wheel leaves the wire.

12,313. APPARATUS FOR OPERATING ELECTRIC SIGNALS FOR ELEVATORS; Henry Pedersen, Brooklyn, N. Y. App. filed June 20, 1902. A slow traveling tube is arranged vertically in the shaft and carries contacts which co-operate with fixed contacts corresponding to the landings and to the circuits whereby when the car approaches a landing, notice will be given to the operator that a passenger is waiting at that landing; notice is also given at the landing to the passenger of the approach of the car.